

Pastureland Conservation Practices

Soil and Water Effects

1. A 6-year comparison of nitrate leaching from grass/clover and N-fertilized grass pastures grazed by sheep.

Cuttle, S. P.; Scurlock, R. V.; and Davies, B. M. S.
Journal of Agricultural Science 131(1): 39-50. (1998)
NAL Call #: 10 J822; ISSN: 0021-8596

Descriptors: grazing/ pastures

Abstract: Nitrate leaching was measured over a 3-year period from rotationally grazed perennial ryegrass (*Lolium perenne* L.) pasture receiving 200 kg fertilizer-N/ha and from similarly grazed ryegrass/white clover (*Trifolium repens* L.) pasture that received no N fertilizer. The results are discussed together with those from the same plots in the preceding 3 years when they were stocked continuously. Under both managements, the numbers of grazing sheep were adjusted on the basis of the quantity of herbage available on the plots. During the whole 6 years, mean nitrate concentrations in soil water collected by porous cup samplers remained below the European Union limit of 11.3 mg N/l except for the fertilized grass plots in year 5 of the study. Quantities of nitrate leached ranged from 6 to 34 kg/ha per year from the grass/clover plots and 2-46 kg/ha from the fertilized plots. Leaching losses from both types of pasture were positively correlated with the numbers of lamb grazing days in the later part of the grazing season. This relationship and the high spatial variability associated with the measurements indicated that N derived from excreta was the main source of leached nitrate. It was concluded that, where pastures of equal productivity are compared, similar quantities of N are likely to be leached from grass/clover swards as from grass swards receiving N fertilizer.

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2. Acidification under grazed annual and perennial grass based pastures.

Ridley, A. M.; Slattery, W. J.; Helyar, K. R.; and Cowling, A.
Australian Journal of Experimental Agriculture 30(4): 539-544. (1990)

NAL Call #: 23 Au792; ISSN: 0816-1089

Descriptors: *Phalaris tuberosa*/ plant/ nitrate leaching/ aluminum sensitive species/ soil management/ crop industry/ agriculture/ Australia

Abstract: Soil samples to a depth of 60 cm were collected from adjacent, 39-year-old, phalaris-*[Phalaris tuberosa]* based and annual pasture fields on an acid soil at Rutherglen, north-eastern Victoria [Australia]. The fields had similar histories of fertiliser application and stock enterprise. Minimum net acid addition rates were determined under both pasture types, and the soil under annual pasture showed greater acidification. Carbon cycle acid addition contributed 1.31 and 1.36 kmol H⁺/ha.year to net acid addition on annual and phalaris pastures, respectively. Because slow alkaline soil reactions in the field contribute to buffering capacity on an acid soil and lead to underestimation of net acid addition rate and nitrate leaching, estimates of such reactions were made for both pasture types. If correct assumptions were used nitrate leaching was substantial under both pasture types but was reduced by 1.01 kmol H⁺/ha.year under phalaris pasture. This suggests that perennial grass based pastures can be used to reduce acidification on pastoral soils. Alkali addition

to counteract net acidification may be necessary on acid soils to maintain management options for growing aluminium-sensitive species.

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3. Agricultural impacts on bacterial water quality in karst groundwater.

Pasquarell, G. C. and Boyer, D. G.

Journal of Environmental Quality 24(5): 959-969. (1995)
NAL Call #: QH540.J6; ISSN: 0047-2425

Descriptors: water quality/ karst/ groundwater pollution/ agricultural practices/ cattle/ bacterial coliforms/ feces/ seasonal variations/ soil water/ springs/ karstic environments/ ground water/ fecal coliforms/ agricultural pollution/ USA, West Virginia/ karstic environments/ ground water/ fecal coliforms/ agricultural pollution/ karst/ cattle/ soil water/ agricultural practices/ feces/ springs

Abstract: A 2-yr study (1991-1992) was conducted in a karst region in southeast West Virginia to determine the impact of agriculture on groundwater quality. The primary agriculture is characterized by seasonal cattle grazing. Fecal coliform densities were measured weekly in the resurgences of three karst basins possessing different degrees of agricultural intensity (79, 51, and 16% land use in agriculture). Fecal coliforms were also measured in a creek at sites upstream and downstream of the known resurgences from the most agriculturally intensive (79%) basin. The fecal coliform densities in the resurgences peaked in the summer and declined in the fall, with a recovery in late winter before the introduction of new cattle. The timing of the recovery indicated that significant storage of fecal material had taken place, which was transported to the groundwater when soil water conditions permitted. For most of each year, soil water effects appeared to have a greater bearing on the fecal coliform densities than did the presence or absence of cattle. The data did not generally support a strong relationship with percent land use in agriculture. This was attributed to the high variability in the data and to low soil moisture during periods of recession that inhibited the transport of fecal material to the groundwater. The karst resurgence springs of the most intensively agricultural basin were contaminated with fecal bacteria. Fecal bacteria concentrations were observed to significantly increase, in the receiving surface stream, from a point upstream of the resurgence springs to a point downstream of the resurgence springs.

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4. Agricultural land-use effects on the indicator bacterial quality of an upland stream in the Derbyshire Peak District in the U.K.

Hunter, Colin; Perkins, Joy; Tranter, Jamie; and Gunn, John

Water Research 33(17): 3577-3586. (1999)

NAL Call #: TD420.W3; ISSN: 0043-1354

Descriptors: agricultural land use intensification/ bacterial contamination/ catchment soils/ ecotoxicology/ health risk/ hydrological transport/ limestone karst system/ precipitation related output/ recreational caving/ seasonal variation/

sheep grazing/ spatial changes/ stream channel/
streamwater quality/ survival/ upland stream/ water inflow
sampling sites

Abstract: Concentrations of indicator bacteria - faecal coliforms (FC) and faecal streptococci (FS) - were monitored at stream and water inflow sampling sites over a 21 month period within a small upland catchment in north Derbyshire, England. Agricultural land-use within the catchment included rough, semi-improved and improved pastures for sheep grazing. During its passage through the catchment, the stream became significantly contaminated by faecal bacteria, suggesting the existence of a semi-permanent store of faecal bacteria in catchment soils, combined with hydrological transport mechanisms capable of moving bacteria from the land to the stream channel. Spatial changes in the bacterial quality of streamwater could be explained by the influence of a number of monitored water inflows to the stream, although a clear and consistent relationship between the bacterial quality of catchment waters and the intensity of adjacent agricultural land-use was not apparent. This is explained in terms of a trade-off between practices which allow land-use intensification and a consequent reduction in the potential for bacterial survival in soils and efficient hydrological transport via surface-water flows. A consistent seasonal pattern of bacterial concentration change was observed, with the highest concentrations occurring during summer months as stocking density increased and the bacterial load store recovered from high precipitation-related outputs during the winter. The extent of faecal bacterial contamination of the stream, particularly during summer months, may constitute a real health risk to recreational users using parts of the limestone karst system into which the stream drains.

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5. An analysis of environmental and economic implications of nil and restricted grazing systems designed to reduce nitrate leaching from New Zealand dairy farms: Pasture production and cost/benefit analysis.

De Klein, C. A. M. and Ledgard, S. F.
New Zealand Journal of Agricultural Research 44(2-3):
217-235. (2001)

NAL Call #: 23 N4892; ISSN: 0028-8233

Descriptors: cost/ benefit analysis/ grazing systems: dairy farms, economic aspects, environmental aspects/ nitrogen loss/ pasture production

Abstract: Nitrate leaching from animal urine is perceived to be a serious consequence of dairy farming. Previous results suggested that nil and restricted grazing systems could reduce nitrate leaching by up to 50%. It is likely that such systems may also increase pasture production. However, potential disadvantages include reduction in the clover content of pastures and increase in capital and/or operating costs. This paper examines the economic implications of nil and restricted grazing systems based on data from an average New Zealand dairy farm and from a long-term farmlet study. The analyses suggested that pasture production increased by about 20% and 2-8%, respectively, compared with a conventional grazing system. Based on the average New Zealand dairy farm, the cost/benefit analysis of the nil grazing system suggested a negative return on capital of about -10%. For the restricted grazing system, the average return on capital was about

9% (range: -4 to 25%) and depended largely on the efficiency of animal excreta use. On farms where an effluent application system is already in place, the average return on capital was 17% (range: 2 to 50%). Based on the farmlet study, the cost/benefit analysis of both grazing systems suggested a small negative return on capital, except when the costs of an effluent application system were excluded. It is concluded that a restricted grazing system for the average New Zealand dairy farm is likely to be economically viable, on farms where an effluent application system or a feed pad is already in place.
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6. An analysis of the physical condition of two intensively grazed Southland soils.

Greenwood, P. B. and McNamara, R. M.
Proceedings of the New Zealand Grassland Association 54:
71-75. (1992)

NAL Call #: 60.19 N48; ISSN: 0369-3902

Descriptors: bulk density/ porosity/ macropores/ hydraulic conductivity/ permeability/ resistance to penetration/ grazing/ physical properties/ soil compaction/ trampling/ soil degradation/ silt loam soils/ soil physical properties/ soil physics

Abstract: The physical properties of two Southland, New Zealand silt loam soils (a yellow-grey earth and a yellow-brown earth) with histories of high and low winter stocking densities of sheep were compared. Assessments were made of mechanical impedance, bulk density, porosity, air permeability and hydraulic conductivity. Results showed that winter treading by sheep on all-grass wintering systems (800-2000 sheep/ha) caused significant soil physical degradation by reducing hydraulically effective soil macroporosity, restricting the transmission of water through the topsoil. This led to waterlogging and root-zone oxygen deficiencies after rain. Soil compaction occurred to nearly the full depth of the A horizon probably as a result of damage over several winters. Measurements of mechanical impedance and bulk density were insensitive to small changes in soil porosity. Air permeability and hydraulic conductivity were good indicators of the relative degree of compactness and both were sensitive to small changes in effective macroporosity.

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7. Animal trampling effects on soil physical properties of two Southeastern U.S. Ultisols.

Tollner, E. W.; Calvert, G. V.; and Langdale, G.
Agriculture, Ecosystems & Environment 33(1):
75-87. (1990)

NAL Call #: S601 .A34; ISSN: 0167-8809

Descriptors: soil physics/ physical properties/ grazing/ animal husbandry/ soil/ soil fertility/ productivity

Abstract: Several selected soil physical properties and plant growth indicators thought to be affected by animal trampling were measured in three experiments ranging over 8 years. Crops studied included lucerne (*Medicago sativa*), Bermudagrass (*Cynodon dactylon*), and soybeans (*Glycine max*) following wheat (*Triticum aestivum*) or rye (*Secale cereale*). Stocking rates for the experiments ranged from 5 to 18 animals/ha. Cone penetrometer measurements were consistently higher in grazed areas than in areas protected from grazing. Other physical parameters (infiltration rate, bulk density, water release curve) measurements were sometimes significantly

influenced by trampling. Natural densification explained increased bulk densities within protected areas. Trampling altered surface soil structure; however, productivity (root biomass, forage growth) was not significantly reduced.
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8. Assessing the effect of management intensive grazing on water quality in the Northeast US.

Stout, W. L.; Fales, S. L.; Muller, L. D.; Schnabel, R. R.; Elwinger, G. F.; and Weaver, S. R.

Journal of Soil and Water Conservation 55(2): 238-243. (2000)

NAL Call #: 56.8 J822; ISSN: 0022-4561

Descriptors: grazing/ animal husbandry/ water quality/ environmental impact/ stocking rate/ dairy farming/ profitability/ nitrates/ leaching/ pastures/ excretion/ soil erosion/ groundwater/ leachates/ Pennsylvania
This citation is from AGRICOLA.

9. Cattle and sheep grazing effects on soil organisms, fertility and compaction in a smooth-stalked meadowgrass-dominant white clover sward.

Murphy, W. M.; Mena Barreto, A. D.; Silman, J. P.; and Dindal, D. L.

Grass and Forage Science 50(3): 191-194. (1995)

NAL Call #: 60.19 B773; ISSN: 0142-5242

Descriptors: *Poa pratensis*/ *Trifolium repens*/ cattle/ sheep/ rotational grazing/ pastures/ range management/ forbs/ soil fertility/ soil compaction/ free-living nematodes/ Rotifera/ earthworms/ nitrogen/ potassium/ phosphorus/ topping/ Vermont
This citation is from AGRICOLA.

10. Cattle grazing impact on surface water quality in a Colorado front range stream.

Gary, H. L.; Johnson, S. R.; and Ponce, S. L.

Journal of Soil and Water Conservation 38(2): 124-126. (1983)

NAL Call #: 56.8 J822; ISSN: 0022-4561

Descriptors: grazing/ environmental impact/ surface water/ water quality/ streams/ microbial pollution/ freshwater pollution/ agriculture/ microbial contamination/ USA, Colorado/ cattle/ microbial contamination/ streams/ microbial pollution

Abstract: Cattle grazing in pastures bisected by a small perennial in central Colorado had only minor effects on water quality during two years of study. Suspended solids and nitrate nitrogen did not increase significantly, and ammonia nitrogen increased significantly only once under moderate rates of grazing. Indicator bacteria densities in the stream water significantly higher when at least 150 cattle were grazing. After removal of cattle or when 40 head of cattle were grazing, bacterial counts dropped to levels similar to those in an adjacent, ungrazed pasture. About 5 percent of the total manure produced by cattle contributed to pollution and/or enrichment of the stream.
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11. Cattle grazing influences on percentage corn residue cover.

Shelton, D. P.; Schroeder, M. A.; Kachman, S. D.; Gosey, J. A.; and Jasa, P. J.

Journal of Soil and Water Conservation 52(3): 203-206. (1997)

NAL Call #: 56.8 J822; ISSN: 0022-4561

Descriptors: soil conservation/ erosion control/ *Zea mays*/ crop residues/ surface layers/ cattle/ grazing/ no-tillage/ fertilizers/ application methods/ sowing/ planters/ crop residue management/ Nebraska
This citation is from AGRICOLA.

12. Cattle treading and phosphorus and sediment loss in overland flow from grazed cropland.

Mcdowell, R. W.; Drewry, J. J.; Muirhead, R. W.; and Paton, R. J.

Australian Journal of Soil Research 41(8): 1521-1532. (2003)

NAL Call #: 56.8 Au7; ISSN: 0004-9573

Descriptors: cattle dung/ cattle treading/ cultivated paddocks/ cultivated soil/ dairy cow treading/ grazed cropland/ overland flow: events, mean suspended sediment concentration/ overland flow volume/ pasture/ sediment loss/ slope positions/ soil disturbance/ soil macroporosity/ soil physical properties

Abstract: This 1-year study investigated the effect of dairy cow treading on soil physical properties and sediment and phosphorus (P) loss via overland flow from pasture and cultivated soil used for wintering dairy cows in southern New Zealand. Treading decreased soil macroporosity and Ksat, and increased overland flow volumes. Treading increased mean suspended sediment concentration in overland flow in the cultivated + trodden treatment (2.6 g/L) compared with ungrazed pasture (0.44 g/L) and ungrazed cultivated (0.98 g/L) treatments over 2 slope positions. Following grazing in the cultivated + trodden treatment, only 25% more sediment was lost in subsequent overland flow events (2.09 and 2.63 g before and after grazing, respectively), and mean total P (TP) losses increased by >250% (from 0.7 to 2.5 mg P). Meanwhile in the cultivated but ungrazed treatment, sediment and TP loss decreased. The increased loss of sediment and P following grazing in the cultivated + trodden treatment was attributed to P from cattle dung, and soil disturbance. Consequently, wintering of animals on cultivated paddocks with forage crops increases the risk of losing much P, especially in particulate form.
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13. Change in the balance of ammonium-N and nitrate-N content in soil under grazed grass swards over 7 years.

Watson, C. J. and Poland, P.

Grass and Forage Science 54(3): 248-254. (1999)

NAL Call #: 60.19 B773; ISSN: 0142-5242

Descriptors: sward/ ammonium nitrogen/ nitrate nitrogen/ soil fertility/ grazing/ range management/ nitrification/ *Lolium perenne*/ *Trifolium repens*/ calcium ammonium nitrate/ steers/ soil microorganisms/ microorganisms/ grassland soils/ application rate/ Northern Ireland

Abstract: The pool of nitrate-N (NO₃⁻-N) in the soil is more prone to losses than that of ammonium-N (NH₄⁺-N) so any shift towards NO₃⁻-N dominance in the soil pools, caused by management intensity, could have environmental implications. The change in the balance of soil NH₄⁺-N and NO₃⁻-N content with time was studied using grazed grass swards receiving different fertilizer N inputs. In addition, the effects of past management on net nitrification of 400 microgram NH₄⁺-N g⁻¹ was investigated in a soil incubation study. Mineral N was determined at frequent intervals (at least every 2 weeks) throughout the

year in the top 5 or 7.5 cm of a sandy clay-loam soil at the Agricultural Research Institute of Northern Ireland at Hillsborough, County Down, for a 7-year period (1989-90 to 1995-96). The treatments were a perennial ryegrass-white clover sward receiving no fertilizer N, together with perennial ryegrass swards receiving 100, 200, 300, 400 or 500 kg N ha⁻¹ year⁻¹ as calcium ammonium nitrate. The plots were continuously grazed by beef steers from April to October to maintain a constant sward height of 7 cm. There was little or no change in average soil NO₃(-)-N and NH₄⁺-N content from 1989-90 to 1995-96 on the grass-clover sward and plots receiving 100 and 200 kg N ha⁻¹ year⁻¹. However, with the plots receiving 300, 400 and 500 kg N ha⁻¹ year⁻¹ NO₃(-)-N became progressively more dominant with time. The incubation study confirmed that this was due to an increase in net nitrification rate. There was evidence that rapid microbial assimilation of NO₃(-)-N occurred during the soil incubations. Past management history can play an important role in determining soil NO₃(-)-N content and hence potential losses of N to the environment. This citation is from AGRICOLA.

14. Changes in a stream's physical and biological conditions following livestock exclusion.

Line, D. E.

Transactions of the ASAE 46(2): 287-293. (2003)
NAL Call #: 290.9 Am32T; ISSN: 0001-2351

Descriptors: BMP/ fecal coliform/ livestock exclusion/ water quality

Abstract: Runoff from dairy cow pastures can degrade the quality of surface waters. Weekly grab samples were collected for 7.5 years from a small stream draining a 56.7-ha, mostly dairy cow pasture and analyzed for fecal coliform and enterococci (streptococci). In situ measurements of pH, dissolved oxygen, temperature, conductivity, and turbidity were made during most grab sampling events. Fecal coliform and enterococci levels for samples collected during the 2.25 years prior to the installation of livestock exclusion fencing were more than 300% greater at the downstream monitoring station compared to the upstream station. After fencing, fecal coliform and enterococci levels decreased 65.9% and 57.0%, respectively. The decreased bacteria levels were significantly different, indicating that livestock exclusion fencing was effective at reducing bacteria levels in the stream. While the levels of dissolved oxygen, pH, temperature, and specific conductivity downstream relative to upstream following fencing generally documented improved water quality, the changes were not statistically significant. Conversely, decreases in turbidity and suspended sediment levels following fencing were significantly different. Levels of most of the physical parameters and bacteria were not significantly different at the upstream monitoring site following the installation of the alternate water supply in the pasture upstream. Thus, the alternate water supply, without fencing, was not effective at improving water quality in the upper pasture.

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15. Changes in soil fungal:bacterial biomass ratios following reductions in the intensity of management of an upland grassland.

Bardgett, R. D.; Hobbs, P. J.; and Frostegard, A.
Biology and Fertility of Soils 22(3): 261-264. (1996)
NAL Call #: QH84.8.B46; ISSN: 0178-2762

Descriptors: soil fungi/ soil bacteria/ biomass/ grassland soils/ upland soils/ range management/ soil management/ sheep/ grazing/ NPK fertilizers/ liming/ soil pH/ community ecology/ biological activity in soil/ estimation/ methodology/ community structure

Abstract: In this study we examined the effect on soil fungal:bacterial biomass ratios of withholding fertiliser, lime, and sheep-grazing from reseeded upland grassland. The cessation of fertiliser applications on limed and grazed grassland resulted in a reduction in soil pH from 5.4 to 5.1. The cessation of fertiliser applications and liming on grazed grassland resulted in a fall in pH from 5.4 to 4.7, whereas withholding fertiliser and lime and the removal of grazing resulted in a further reduction to pH 4.5. Substrate-induced respiration was reduced in the unfertilised grazed (21%; P<0.01) and unfertilised ungrazed (36%; P<0.001) treatments. Bacterial substrate-induced respiration and bacterial fatty acids were unaffected by the treatments. The relative abundance of the fungal fatty acid 18:2 omega 6 increased by 39 and 72% (P<0.05) in the limed grazed and unfertilised grazed treatments, respectively. Fungal substrate-induced respiration increased in the limed grazed (18%) and unfertilised grazed (65%; P<0.05) treatments. The ratio of 18:2 omega 6: bacterial fatty acids was correlated with the ratio of fungal:bacterial substrate-induced respiration (r=0.69; P<0.001).

This citation is from AGRICOLA.

16. Changes of surface soil nutrients and sustainability of pastoralism on grazed hilly and steep land, South Island, New Zealand.

McIntosh, P. D.; Ogle, G. I.; Patterson, R. G.; Aubrey, B.; Morriss, J.; and Giddens, K.

Journal of Range Management 49(4): 361-367. (1996)
NAL Call #: 60.18 J82; ISSN: 0022-409X

http://jrm.library.arizona.edu/data/1996/494/361-367_mcintosh.pdf

Descriptors: sheep/ grazing/ upland soils/ cation exchange capacity/ topsoil/ pH/ highlands/ New Zealand
Abstract: Soil nutrients in topsoils (0-7.5 cm) on grazed hilly and steep land on 2 high country sheep farms with contrasting climate in the upper Waitaki district, South Island, New Zealand, were compared before and after a 14-15 year period. In addition, effects on soils of 2 farm management systems were compared by sampling similar soils on adjacent farms. On a farm with mean annual rainfall of 700-1,000 mm (study area A) that had been fertilised and oversown, and grazed with about 1.6 ewe equivalents per hectare for 14 years, levels of exchangeable cations (Ca, K, Mg) increased in topsoils on sunny slopes, but there was little change on shady slopes. The Ca increase on sunny slopes was the increase to be expected from the amount of Ca contained in the superphosphate applied but increases of exchangeable K and Mg could not be explained by fertiliser additions. There was an overall 29% increase of CEC, 7.5% decline of base saturation, and decline of soil pH by 0.4 units over the 14 year period. On a farm with mean annual rainfall of 500-600 mm (study area B) that had been grazed for 15 years with about 0.6 ewe equivalents per hectare but not fertilised or oversown, levels of exchangeable cations in topsoils declined. Base saturation values declined from 98% to 73% and pH declined by 0.4 units. Losses of Ca and Mg were greater than could be explained by direct effects of sheep grazing and we conclude that processes such as erosion or

removal of vegetation and nutrients by rabbits are important loss pathways. In the spatial comparison on land with mean annual rainfall of approximately 1,000 mm, oversown and fertilised soils (grazed with about 1.6 ewe equivalents per hectare) had higher levels of exchangeable cations, organic C and total N than soils that had neither been oversown or fertilised (grazed with about 0.6 ewe equivalents per hectare). Questions of ecological and economic sustainability arise both on the moister and drier high country. On moister land like area A, if lime can be applied economically, and fertiliser can continue to be applied with positive financial returns, oversowing and fertilising may be sustainable on sunny slopes. The sustainability of pastoralism on shady slopes is more problematical. If on drier land losses of topsoil nutrients such as those measured on area B are widespread, they are considered to be unsustainable. Although the nutrients lost could be readily replenished using modest amounts of fertiliser and lime, the changes have occurred concurrently with declines of organic C and total N. Restoration of organic matter levels is likely to require either reduced grazing, or oversowing and application of fertiliser. Because oversowing and fertilising the drier high country is not financially viable except during periods of high commodity prices, both these options would require major changes in farm management and/or financial assistance with soil conservation measures.

This citation is from AGRICOLA.

17. Changes to soil physical properties after grazing exclusion.

Greenwood, K. L.; MacLeod, D. A.; Scott, J. M.; and Hutchinson, K. J.

Soil Use and Management 14(1): 19-24. (1998)

NAL Call #: S590.S68; ISSN: 0266-0032

Descriptors: pastures/ soil degradation/ bulk density/ unsaturated hydraulic conductivity/ sheep/ grazing/ stocking rate/ rain/ evaporation/ New South Wales

Abstract: The potential for degraded physical properties of soil to regenerate naturally after exclusion of grazing animals was examined at a long-term stocking rate trial near Armidale, New South Wales, Australia. Unsaturated hydraulic conductivity was measured before grazing was excluded, and after 7 months and 2.5 years' grazing exclusion. These data were compared with controls grazed at 10,15 and 20 sheep/ha. After 2.5 years, there were significant increases in unsaturated hydraulic conductivity at 5 and 15 mm tension in the ungrazed treatments compared with the grazed controls. The unsaturated hydraulic conductivities and bulk density of surface soils under pasture which had been ungrazed for 2.5 years were comparable to those where the pasture had been ungrazed for 27 years. We speculate that the natural amelioration of soil physical properties in these soils was due to biological activity and wetting and drying cycles, in the absence of the compactive effect of animal treading.

This citation is from AGRICOLA.

18. Channel changes over 12 years on grazed and ungrazed reaches of Wickiup Creek in eastern Oregon.

Nagle, G. N. and Clifton, C. F.

Physical Geography 24(1): 77-95. (2003); ISSN: 0272-3646

Descriptors: channels/ streams/ grazing/ pastures/ geography/ reach/ livestock

Abstract: Stream channel cross sections were first

compared in 1986 in grazed reaches and inside a 47-yr.-old grazing enclosure along Wickiup Creek in eastern Oregon. Significant differences between grazed and ungrazed channels were found at that time. In 1998, we measured 49 cross sections placed at a similar spacing inside the enclosure and in three grazed reaches in order to examine changes over 12 yr. Although the grazed channels were still significantly different than the ungrazed, in two out of three grazed reaches, the channels showed improvement in all parameters since 1985 although not all of these were statistically significant at the 90% level. Since 1990, the Wickiup riparian pasture has been managed more cautiously than many other streamside pastures in eastern Oregon and our results indicate that under careful grazing management, stream channels may show improvement from destructive past grazing without complete exclusion of livestock. As an alternative to the intensive method of measuring channel cross sections that was used in this study, we propose a rapid method of measuring stream channels that might be more useful in future studies of riparian grazing impacts.

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19. Chemical water quality of runoff from grazing land in Nebraska: Contributing factors.

Schepers, J. S.; Hackes, B. L.; and Francis, D. D.

Journal of Environmental Quality 11(3): 355-359. (1982)

NAL Call #: QH540.J6; ISSN: 0047-2425

Descriptors: farm management/ livestock/ pastures/ precipitation/ runoff/ agricultural runoff/ water quality/ animal wastes/ manure/ vegetation/ wildlife/ nutrients/ organic matter/ nitrates/ phosphorus/ chlorides/ ammonium/ water pollution sources/ fate of pollutants/ grazing/ farm wastes/ nonpoint pollution sources/ Nebraska

Abstract: The effects of climatic factors, hydrologic factors, and management practices on the chemical quality of runoff from a 32.5 ha cow and calf pasture in Nebraska were studied in 1976-78. Precipitation and hydrologic characteristics, stocking rates, and sediment contents in the runoff were used to predict the average concentrations of ammonium-N, nitrate-N, Kjeldahl N, soluble P, total P, total organic carbon, COD, and chloride. Animal stocking density significantly influenced the predicted concentrations of ammonium-N, nitrate-N, total P, total organic carbon, and COD in the runoff. However, dilution was the dominant process. Likely sources of pollutants were standing plant material and manure. Chloride appeared to be an indicator of wildlife activity.

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20. Chemical water quality of runoff from grazing land in Nebraska: Influence of grazing livestock.

Schepers, J. S. and Francis, D. D.

Journal of Environmental Quality 11(3): 351-354. (1982)

NAL Call #: QH540.J6; ISSN: 0047-2425

Descriptors: pastures/ runoff/ water quality/ farm management/ animal wastes/ manure/ vegetation/ wildlife/ nutrients/ organic matter/ nitrates/ phosphorus/ chlorides/ ammonium/ water pollution sources/ fate of pollutants/ livestock/ grazing/ farm wastes/ nonpoint pollution sources/ Nebraska

Abstract: The quality of runoff water from a 32.5 ha cow and calf pasture in Nebraska was studied for three years, 1976-78. Three types of pastures were included: ungrazed pasture (control), grazed pasture with livestock actively

grazing, and grazed pasture with livestock absent. The runoff water from pasture with actively grazing livestock had higher concentrations of all water quality parameters with respect to the grazed pasture with no livestock present, with the exception of Kjeldahl N, which decreased by 19%. The increases were: total solids, 52%; total organic carbon, 11%; COD, 7%, ammonium-N, 6%, nitrate-N, 45%; total P, 37%; soluble P, 48% and chloride, 78%. Runoff from the control area was tea-colored and had the poorest quality, with 1.94 to 10.8 times greater concentrations of pollutants. This was attributed to wildlife activity and leaching of nutrients and organic matter from vegetation.

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21. A comparison between continuous and controlled grazing on a red duplex soil: Effects on soil physical characteristics.

Proffitt, A. P. B.; Bendotti, S.; and Mcgarry, D.
Soil and Tillage Research 35(4): 199-210. (1995)

NAL Call #: S590.S48; ISSN: 0167-1987

Descriptors: controlled grazing/ hardsetting/ no grazing/ plastic limit/ set stocking/ structural deterioration/ trampling

Abstract: The effect of sheep trampling and grazing management practice on soil physical characteristics was examined over one pasture season. The soil studied was a fragile sandy clay loam (red duplex soil) located in a dryland agricultural area (307 mm average annual rainfall) of Western Australia. The pasture was predominantly *Serena medic* (*Medicago polymorpha*). The three grazing management practices investigated were: (i) traditional set-stocking (where sheep were grazed continuously for 17 weeks, beginning soon after the start of the early winter rains); (ii) controlled grazing (where sheep were temporarily removed from the enclosure when the topsoil was close to its plastic limit); (iii) no grazing (where the pasture was mown to simulate grazing without trampling). Topsoil structure was assessed in several ways: dry bulk density, infiltration rate and tensile strength measurements, and image analysis of resin-impregnated soil blocks. At the end of the grazing period, all soil structure attributes measured showed that topsoil structure under the controlled grazing practice was not only superior to that found under the traditional set-stocking practice, but similar to that found in the ungrazed treatment. Soil remoulding appeared to be a significant process contributing to the deterioration in topsoil structure. The plastic limit was used diagnostically and found to be an important soil property which should be routinely determined in order to aid management decisions. Continuous (or set-stocking) grazing practices in the pasture phase of wheat (*Triticum aestivum*): pasture rotations can exacerbate the susceptibility of red duplex soils to structure deterioration and hardsetting. However, the degree of structure deterioration inflicted by stock can be minimized by removing stock for brief periods when the soil is close to its plastic limit.

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22. Curtailing grazing-induced erosion in a small catchment and its environs, the Peak District, Central England.

Evans, R.

Applied Geography 25(1): 81-95. (2005); ISSN: 0143-6228

Descriptors: erosion/ grazing/ peat/ sheep/ vegetation colonisation

Abstract: Eroding slopes within a small catchment in the Peak District, Central England, and its environs have been monitored since 1966. A reduction in sheep grazing pressure in the late 1960s, due to a harsh winter and a poor crop of lambs, led to colonisation of bare soil on lower slopes, but not on higher exposed slopes. Sheep grazing pressure was permanently reduced in the 1980s as part of a new grazing regime. Many formerly eroding sheep scars in the small catchment have over time become completely colonised by vegetation and only those scars still actively used by sheep remain. It took two decades before vegetation began to invade the bare soil on the higher slopes. There, it was not until all the peat and the underlying leached (Ea) soil horizon was stripped off that vegetation was re-established. Colonisation is a rapid process and c.80% of the bare soil is covered within 5-10 years. Factors other than sheep grazing pressure that exacerbated erosion were a cooling climate in the 1960s and the presence of cattle on the slopes. Temperatures have risen since then and cattle no longer graze the slopes.

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23. Dissolved organic carbon losses from grazed grasslands under different management regimes.

Mctiernan, K. B.; Jarvis, S. C.; Scholefield, D.; and Hayes, M. H. B.

Water Research 35(10): 2565-2569. (2001)

NAL Call #: TD420.W3; ISSN: 0043-1354

Descriptors: grasslands/ grazing/ fertilizers/ drainage/ watershed management/ organic carbon/ on-site investigations/ dissolved organic matter/ dissolved organic carbon/ soils/ drainage water/ nitrogen/ resource management/ waterlogged/ land (grass and pasture)/ land/ organic matter/ biogeochemistry/ soil/ grazed grassland

Abstract: Dissolved organic matter (DOM) is fundamental to many biogeochemical processes in soils and natural waters. Despite the large number of studies reporting on DOM losses from forest soils and in surface waters there is little published data on exports from managed grasslands. The objective of our study was to determine the extent of short-term exports of dissolved organic carbon (DOC) from managed grazed grasslands and to evaluate the influence of fertilizer management and drainage regime. DOC discharged from grazed grassland plots, with a range of management strategies, was determined over 2 months. Total export varied from 42 to 118 kg C ha⁻¹ super(-1), and was greater from some plots than literature estimates for annual losses from all catchment types. There was a significant ($P = 0.048$) positive correlation between DOC export and rates of nitrogen application for treatments with no artificial drainage. Increased dry matter production arising from increased fertilizer-N inputs is suggested as an important factor in this relationship. DOC export was significantly ($P = 0.032$) reduced by artificial drainage and adsorption of DOC to soil surfaces and the restriction of decomposition due to waterlogging are suggested as two possible explanations.

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24. A drained plot study of the impact of cutting and/or grazing management and N fertilization on nitrate leaching under grassland.

Decau, M. L. and Le Corre, L.

In: Grassland and Society: 15th General Meeting of the European Grassland Federation. (Held 6 Jun 1994-9 Jun 1994 at Wageningen, Netherlands.)

Wageningen, Netherlands: Wageningen Pers; pp. 382-386; 1994.

NAL Call #: QK938.P7E97 1994; ISBN: 9074134157

Descriptors: book chapter/ meeting poster/ nitrogen/ pollution/ soil

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25. Economic and environmental impacts of pasture nutrient management.

Osei, E.; Gassman, P. W.; Hauck, L. M.; Neitsch, S.; Jones, R. D.; McNitt, J.; and Jones, H.

Journal of Range Management 56(3): 218-226. (2003)

NAL Call #: 60.18 J82; ISSN: 0022-409X

Descriptors: dairy cows/ grazing/ stocking rate/ soil nutrient balance/ nutrient management/ nitrogen/ phosphorus/ simulation models/ dairy farm management/ production costs/ farm size/ fertilizer application/ application rate/ agricultural runoff/ costs and returns/ pollution control/ Texas

Abstract: Highly intensive stocking of dairy cattle on continuously grazed pasture coupled with liberal applications of commercial fertilizer can lead to increased losses of agricultural nutrients, which is a concern for water quality of receiving lakes and surface water resources. Integrated economic-environmental model simulations performed for the Lake Fork Reservoir Watershed in northeast Texas indicate that appropriate pasture nutrient management including stocking density adjustments and more efficient commercial fertilizer use could lead to significant reductions in nutrient losses. Soluble and organic P losses were predicted to decline by 54 and 13% relative to baseline conditions when manure P was assumed totally plant available (Low P scenario). The soluble and organic P loss reductions declined to 33 and 7% when only inorganic P was assumed plant available (High P scenario). Simulation of an N-based manure management plan resulted in the smallest predicted soluble and organic P loss reductions of 18 and 3%. Nitrogen loss predictions ranged from a 7% decline to a 1% increase for the 3 scenarios as compared to the baseline. The High P and Low P scenarios resulted in estimated aggregate profit reductions of 6 and 18% relative to the baseline. These profit declines occurred because the dairies had to acquire additional pasture land to accommodate the expanded area required for the P-based scenarios. In contrast, the N-based stocking density and nutrient management scenario resulted in an aggregate profit increase of 3% across all dairies. Variations in economic impacts were also predicted across farm sizes.

This citation is from AGRICOLA.

26. Effect of cattle and sheep treading on surface configuration of a sedimentary hill soil.

Betteridge, K.; Mackay, A. D.; Shepherd, T. G.; Barker, D. J.; Budding, P. J.; Devantier, B. P.; and Costall, D. A.

Australian Journal of Soil Research 37(4): 743-760. (1999)

NAL Call #: 56.8 Au7; ISSN: 0004-9573

Descriptors: downward movement/ grazing/ pastures/

disturbed soils/ grassland soils/ soil types/ soil compaction/ soil physical properties/ upland soils/ livestock/ soil mechanics/ trampling/ surface roughness

Abstract: Pastures with a 6-year history of grazing by cattle (cattle pasture) and sheep (sheep pasture) in New Zealand were used to measure the effects on soil disturbance of a single severe grazing/treading event by sheep (S), one by cattle (C1), or 2 events within 3 weeks by cattle (C2).

Treatments were stocked at 35 500 kg LW [liveweight]0.9/ha (? 200 cattle/ha) for 48 h when the soil was wetter than the plastic limit. A control plot (untrodden, U) was grazed only lightly by sheep to control pasture cover while causing minimal observable surface damage. Change in surface contour, random roughness, soil surface damage, and pasture cover were determined with a 'contometer'. The construction and use of the contometer to measure change in microtopography and to describe the soil surface and vegetative state by grazing is described. Disturbance was calculated as the change in height (mm) of soil level at fixed positions along transects within treatment plots. Both sheep and cattle pastures were affected similarly ($P > 0.05$) in relation to absolute and net disturbance of soils. Averaged across both pasture types, very little absolute surface soil disturbance was measured on S, whereas cattle-treading caused significant upward and downward movement of soil. Mean (+or-s.d.) absolute surface disturbance (sum of upward and downward movement on a transect) was greater by cattle (C1, 11.2 +or-8.1; C2, 9.9 +or-5.0 mm) than by sheep (5.1 +or-1.8 mm) ($P < 0.01$) after the single treading and 9.0 +or-4.1 mm for C2 after the second treading. Net disturbance (average of upward and downward movement on a transect) was 1.9 +or-4.0, 1.8 +or-4.0, and 3.0 +or-1.8 mm for C1, C2, and S ($P > 0.05$), respectively, after the first treading and 4.1 +or-3.7 mm for C2 after the second treading. Cumulative net disturbance resulting from C2 on sheep pasture was greater than cattle pasture ($P < 0.05$), especially after the first treading, which suggested sheep pasture was more susceptible to compaction than the previously damaged cattle pasture. Random roughness and percentage of surface soil penetrated by hooves, based on observation, was greater with cattle than sheep treading. Random roughness increased ($P < 0.07$) following treading of sheep than of cattle pastures. It was concluded that the effect on soil surface configuration of severe short-term treading events on wet soils was greater by cattle than by sheep stocked at the same metabolic liveweight per hectare and that this occurred irrespective of the previous grazing history. Although absolute disturbance in each of the 2 cattle treadings in C2 was similar, net disturbance (compaction) on sheep pasture was more than twice that on cattle pasture ($P < 0.05$).

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27. Effect of grassland management on nitrogen mineralization potential, microbial biomass and nitrogen yield in the following year.

Hassink, J.

Netherlands Journal of Agricultural Science 40(2): 173-185. (1992)

NAL Call #: 12 N3892; ISSN: 0028-2928

Descriptors: fertilizer/ grazing/ herbage dry matter production/ mowing

Abstract: The effect of mowing or grazing and mineral fertilizer level on N mineralization potential and microbial

biomass N (N flush) was studied in 1988 on a sandy soil and a sedimentary calcareous silty loam (loam). On the loam the residual effect of the treatments on N yield and herbage dry matter accumulation in the following year was also studied. The different management practices were started in 1985 on the sandy soil and in 1986 on the loam. The amount of microbial biomass N was larger under grazing than under mowing. The increase in the amount of microbial biomass N due to grazing was larger for the loam than for the sandy soil. The N-mineralization rate was higher under grazing than under mowing. The difference in N-mineralization rates between grazed and mown fields was 20-30% in April for both soils, but increased considerably in the sandy soil during the growing season. It was estimated that the difference in N-mineralization between mown and grazed plots under field conditions was 110 and 40 kg N ha⁻¹ year⁻¹ in the sandy soil and the loam, respectively. Thus the optimum N fertilizer application rate should be considerably lower under grazing conditions than under mowing conditions, especially on sandy soil. Fertilizer level had no effect on the amount of microbial biomass and rates of N-mineralization. Both grazing compared to moving and increasing N fertilizer levels above 550 kg N ha⁻¹ year⁻¹ affected the N yield and dry matter accumulation in the following year (= residual effects) on the loam. These effects were greater for N yield than for dry matter accumulation. The residual effect of previous fertilizer input was probably caused by the presence of different amounts of N in roots and stubble. The residual effect on N yield under grazing exceeded that under mowing by 28%.

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28. Effect of grassland management on the amounts of soil organic nitrogen and carbon.

Hassink, J. and Neeteson, J. J.

Netherlands Journal of Agricultural Science 39(4): 225-236. (1991)

NAL Call #: 12 N3892; ISSN: 0028-2928

Descriptors: grazing/ mowing/ fertilizer

Abstract: In the period 1985-1990 field trials with N fertilization, grazing and mowing were conducted on a sandy soil and a loamy soil to investigate the accumulation of organic N and C in intensively managed grassland systems. Annual fertilizer rates of N varied from 250 to 700 kg ha⁻¹ under grazing and from 0 to 700 kg ha⁻¹ under mowing. On the grazed plots no significant accumulation of soil organic N occurred in the sandy soil, whereas in the loamy soil an average N accumulation of 245 kg ha⁻¹ yr⁻¹ was found. The accumulation in the loamy soil was probably caused by the marine history of the soil and the fact that the soil was recently plowed and resown. The accumulation was independent of the level of fertilizer N applied, indicating that increased biomass production does not necessarily increase the return of dead organic material to the soil. These results confirm the suggestion that the surplus of fertilizer N is largely lost to the environment. About four years after the start of the experiment the amounts of soil N and C were considerably higher under grazing than under mowing. In spite of the higher amount of soil N under grazing compared to mowing, approximately 71% and 57% of the extra amount of N returned to the soil by grazing is lost to the environment on the sandy and the loamy soil, respectively. The C/N ratio of the soil organic matter was lower in plots with fertilizer N application than in

plots without fertilizer N. This difference was probably caused by a difference in C/N ratio of dead grass and roots that were returned to the soil.

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29. The effect of grazing on soil microbial biomass and community on alpin pastures.

Insam, H.; Rangger, A.; Henrich, M.; and Hitzl, W.

Phyton (Horn) 36(3): 205-216. (1996)

NAL Call #: 450 P565; ISSN: 0079-2047

Descriptors: agronomy/ alpine pasture/ animal husbandry/ ecophysiology/ grazing/ litter quality/ respiration/ soil microbial biomass/ soil conditions/ terrestrial ecology

Abstract: Within in a multidisciplinary project the effect of termination of cattle grazing on grassland and forest on soil microbial properties was investigated. The changes of microbial biomass (C-mic), basal respiration and the ecophysiological parameters (metabolic quotient and the C-mic:C-org ratio) were small. Mainly in the dry summer of 1993 an increase of basal respiration, microbial biomass and the C-mic:C-org ratio was observed for the fenced in sites. The effects were not observed in the moist summer of 1995. For the pasture site, a substrate utilization assay employing 95 different C sources (Biolog) indicated some changes in the functional abilities of the bacterial communities after 9 years of protecting the site from grazing. The changes were attributed to a change of litter quality.

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30. The effect of improved pastures and grazing management on soil water storage on a basaltic plains site in south-west Victoria.

Bird, P. R.; Jackson, T. T.; Kearney, G. A.; Saul, G. R.; Waller, R. A.; and Whipp, G.

Australian Journal of Experimental Agriculture 44(6): 559-569. (2004)

NAL Call #: 23 Au792; ISSN: 0816-1089

Descriptors: rotational grazing/ applied and field techniques/ basalt/ grazing management/ groundwater recharge/ pasture/ rainfall/ soil salinity

Abstract: Soil salinity of non-irrigated farmlands in Australia has been largely attributed to tree clearing and their replacement by annual pasture and crop species. This paper deals with the effects of sowing perennial ryegrass and greater inputs of fertiliser, and the effect of grazing management, on water use and the potential to improve recharge control on a gravelly soil derived from basalt. In 1991, neutron access tubes were inserted into plots on a project established in 1989 to examine the impact of upgrading the pasture on sheep productivity. These plots were subdivided in 1996 to examine the impact of grazing management (tactical v. set-stocking) and pasture type (pastures dominated by annual species v. upgraded pastures) on productivity. Neutron probe readings were taken periodically from tubes in each plot, at depth intervals of 25 cm (December 1991-March 1995) or 20 cm (August 1995-April 1999) to 170 cm. There was no effect of treatment on soil moisture. Data for 2 wet years (1995 and 1996) indicate that the effective soil water storage capacity to 170 cm depth for these pastures was a mean of 125 mm of water. This represents the potential buffer before winter rainfall exceeds the water use by the pasture, fills the soil profile to capacity and then either runs off or allows deep drainage to occur. We did not achieve a significant

reduction in soil water storage, and therefore potential recharge of groundwater, by re-sowing the pasture with perennial ryegrass and applying more fertiliser, or by altering the grazing management to a form of rotational grazing. Compared with set-stocked annual pasture, the impact of such treatments was to reduce soil water storage to a depth of 170 cm in autumn by less than 20 mm/year. There was no association between total herbage production and soil water storage, however, an increased percentage of perennial ryegrass in the pasture was associated with a small reduction in soil water storage in 1 year. Greater use of soil water may depend upon using deeper-rooted perennials or maintaining a higher proportion of perennial species in the sward (the perennial ryegrass in the re-sown pastures declined from 53% in October 1996 to 4% in October 1998).

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31. The effect of livestock grazing on surface runoff and soil erosion from sloping pasture lands in the Ethiopian highlands.

Mwendera, E. J.; Saleem, M. A. Mohamed; and Dibabe, A. *Australian Journal of Experimental Agriculture* 37(4): 421-430. (1997)

NAL Call #: 23 Au792; ISSN: 0816-1089

Descriptors: livestock industry/ animal husbandry/ biobusiness/ grazing/ pasture land/ slope/ soil erosion/ soil science/ surface runoff

Abstract: Effects of livestock grazing on surface runoff and soil erosion at varying slopes were studied in pasture lands within Ginchi watershed, Ethiopia. The results showed that livestock grazing in the watershed followed distinct seasonal and spatial patterns. During the rainy season, grazing pressure was greatest on the upper slopes (gt 5% slope) while the pressure shifted to the lower slopes during part of the dry season. Seasonal grazing pressure in different parts of the watershed was further complicated by the fact that during the rainy season and immediately after the rains, grazing was limited to individually designated pasture lands while during most part of the dry season, the entire watershed became a common grazing resource for livestock of watershed residents as well as those farmers outside the watershed. It was observed that, on pastures above 4.2% slope, there is the risk of erosion rates exceeding the estimated soil loss tolerable limit under the current grazing pressures (heavy grazing), while slopes exceeding 5.8% are likely to suffer soil erosion under moderate grazing pressure at the current level of biomass productivity. Since livestock are mobile, farmers tend to take advantage of this attribute by seasonally moving the livestock to different parts of the watershed. This study has demonstrated the need for better understanding of the resource use patterns beyond the individual farmlands, most preferably at watershed level, so that on-site and off-site effects of seasonal concentration of livestock can be incorporated into developing feed production and management strategies for improving the system productivity and environmental protection.

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32. Effect of retention of run-off water and grazing on soil and on vegetation of a temperate humid grassland.

Alconada, M.; Ansin, O. E.; Lavado, R. S.; Deregibus, V. A.; Rubio, G.; and Gutierrez Boem, F. H.

Agricultural Water Management 23(3): 233-246. (1993)

NAL Call #: S494.5.W3A3; ISSN: 0378-3774

Descriptors: temperate zones/ grasslands/ runoff farming/ grazing/ water management/ animal husbandry/ temperate grasslands/ water relations/ trampling

Abstract: A 4-year field trial was carried out on a Typic Natraqualf to modify surface runoff, to change the soil water regime and improve forage productivity. Water was retained by earth banks which were built along contour lines. The area was grazed by cattle at a density of six animal units per hectare during five or six occupation periods per year. To study the effect of cattle trampling, 1 ha within the water retention area was excluded from grazing. It was found that surface accumulation of water led to higher soil water contents and prevented salt rising by capillarity from the water table (electrical conductivity of A1 horizon, 1.4 dS/m against 3.4 dS/m in the control area). Soil salinization in the control area was associated with soil water evaporative losses and a water table depth <1.5 m. Soil alkalinity (pH and SAR) showed variations closely related to salinity. The already impaired soil physical properties were not significantly affected by livestock trampling in the water retention area. A marked change in plant community composition was observed. Most halophytic species disappeared and the area was covered by hydrophilous grasses. This contributed to the fourfold increase forage. Runoff water retention proved to be a promising way to change temporarily the status of the soil and to cause a large change in grassland characteristics and productivity.

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33. Effect of rotational grazing on selected physical properties of a gleyed brunisolic gray luvisol loam in Nova Scotia.

Rodd, A. V.; Papadopoulos, Y. A.; Laflamme, L. F.; Mcrae, K. B.; Fillmore, S. A. E.; and Wilson, R. W.

Canadian Journal of Soil Science 79(1): 117-125. (1999)

NAL Call #: 56.8 C162; ISSN: 0008-4271

Descriptors: bulk density/ hydraulic conductivity/ penetration resistance/ physical properties/ rotational grazing/ gleyed brunisolic gray luvisol loam

Abstract: Low organic matter content and weak soil structure, combined with high annual precipitation, make the soils of the Maritime Provinces extremely susceptible to compaction. Although many pasture studies have been conducted in the Maritime Provinces, none has investigated the impact of pasturing cattle on soil physical properties. Soil properties such as resistance to penetration, bulk density and hydraulic conductivity were monitored on pasture swards receiving various rotational-grazing intensities. These parameters were measured concomitantly on traffic-free areas that had been harvested as conserved forage. Resistance to penetration measurements indicate that a significant amount of compaction by cattle occurred during the 1990, 1991 and 1992 grazing seasons. Penetration resistance was generally greatest in the top 6 cm of soil, but was alleviated by frost action during the subsequent winter and spring. The other soil parameters measured were either more variable (surface and subsurface saturated hydraulic conductivity) or less sensitive (bulk density) to compaction. Although more variable, surface hydraulic conductivity was significantly higher in the traffic-free conserved forage areas than in the pasture paddocks. Rest intervals between grazings had no significant effect on saturated hydraulic conductivity. Seasonal change in resistance to penetration

generally increased as rest interval decreased. The timothy/alfalfa swards (little alfalfa was left in the pastures by 1992) had the least seasonal change in resistance to penetration.

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34. Effect of short term pastures on soil nitrogen status under contrasting management practices.

Williams, P. H. and Wright, C. E.

Proceedings Annual Conference Agronomy Society of New Zealand 27: 139-143. (1997)

NAL Call #: S3.A37; ISSN: 0110-6589

Descriptors: nitrogen fertilizers/ application rates/ grazing/ mineral uptake/ nutrient uptake/ seed production/ straw/ wheat/ nitrogen fixation/ residual effects

Abstract: In a field trial in 1993-95 at Lincoln, New Zealand, mixtures of *Lolium perenne* cv. Grasslands Supernui and *Trifolium repens* cv. Grasslands Tahora were grazed by sheep or managed for seed production. Under grazing, *T. repens* fixed 55 kg N ha⁻¹ year⁻¹, and the net input to the soil was 84 kg N ha⁻¹ over the two years. In the first year under seed production when *L. perenne* seed was harvested, *T. repens* fixed only 21 kg N ha⁻¹, but 100 kg N ha⁻¹ was applied in fertilizer. In the second year, when *L. perenne* was killed by herbicide and *T. repens* seed harvested, 134 kg N ha⁻¹ was fixed and 25 kg N ha⁻¹ fertilizer was applied. However, N was removed in harvested seed (15 kg N ha⁻¹ in *L. perenne* seed and 30 kg N ha⁻¹ in *T. repens* seed) and *L. perenne* straw (65 kg N ha⁻¹). Overall, the net input of N to the soil under seed production (157 kg N ha⁻¹) was greater than under grazing (84 kg N ha⁻¹). Despite the higher net N input to the soil under seed production, there was no evidence that this had a beneficial effect on wheat cv. Sapphire in a subsequent greenhouse pot trial, and there was a higher dry matter yield and N uptake from the wheat following grazing than seed production. The carryover effect of the two management practices on the wheat appeared to be linked to the form of N added to the soil, rather than the total amount of N added.

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35. Effect of two different grazing intensities on the rotational methods with dairy cattle: Nutrients recycling in the soil from the dairy cattle feces.

Reyes, J.; Vidal, Ibis; Gonzalez, Maria R.; Gonzalez, Rosa M.; and Fonte, Damaris

Cuban Journal of Agricultural Science 37(2): 161-166. (2003)

NAL Call #: S1.R4; ISSN: 0864-0408

Descriptors: grazing rotation method: applied and field techniques/ dung patches/ red ferrallic soil

Abstract: For determining the contribution of cattle feces to the soil in each grazing intensity with low inputs, a study was conducted for four years on a red ferrallic soil planted with star grass (*Cynodon nlemfuensis*) and submitted to two grazing intensities (high (HI), 184.4 LAU/ha and low intensity (LI), 101.2 LAU/ha, as average). High stocking rates, 3.7 and 3.2 LAU/ha/year, for HI and LI, respectively, were used. The statistical analysis used was a linear model of fixed effect. Treatment, season, year and their interaction were controlled. The results showed that the number of dung patches deposited in the paddocks (dung patches/animal/d) did not differ between treatments; while the highest (P<0.05) number of dung patches was reported

in the rainy season. The deposition of total dung patches (dung patches/ha/year) was higher (P<0.01) in the four years with HI, in 37.2, 30.4, 18.3 and 15.0%, respectively, compared to LI. The percentage of the area covered by the dung patches did not surpass 10.5% in any case. However, the method of HI surpassed (P<0.001) to that of LI in all the years (2.7, 1.4, 1.2 and 1.2 more from the first to the fourth year, respectively). The contribution of organic matter was higher in the four years (P<0.01) in the HI method (868.2, 698.3, 692.9 and 1104.9 kg of organic matter/ha/year), while the contribution of nitrogen, phosphorus and potassium by total feces (dung patches and urine) was higher (P<0.001) in HI, which represented 29.1, 40.9 and 24.6% for nitrogen, phosphorous and potassium, respectively, as average. The results confirmed that the contribution of nutrients to the soil is higher by using higher grazing intensities. However, further studies are suggested to prove that there is a balance in the system, in general, and in the soil, in particular, with thees intensities.

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36. Effect of urine volume on nitrate leaching in the northeast USA.

Stout, W. L.

Nutrient Cycling in Agroecosystems 67(2): 197-203. (2003)

NAL Call #: S631 .F422; ISSN: 1385-1314

Descriptors: field experiment: applied and field techniques/ large drainage lysimeter: field equipment/ Hagerstown silt loam soil: fine, mesic typic hapludalf, mixed/ grazing/ nitrate leaching: urine volume effects/ water quality

Abstract: To investigate how the urine volume (i.e. size of cow) affects how much NO₃-N is leached from a urine deposition in the climatic conditions of the northeast USA, a field study using large drainage lysimeters to measure NO₃-N leaching loss from synthetic urine applied in spring, summer and fall in 1-, 2-, and 3-1 volumes to an orchardgrass (*Dactylis glomerata* L., c.v. 'Pennlate') sward was conducted from April 1997 to March 1999. The study site was located in central Pennsylvania on a Hagerstown silt loam soil (fine, mixed, mesic Typic Hapludalf). It was found that increasing urine volume increased the amount of urine N leached but had no significant effect on the apparent percent of urine N leached. The apparent percent of urine N leached was 25% averaged over all treatment times and volumes and was 21% for spring and summer applied urine and 32% for fall applied urine.

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37. The effects of agricultural management on the soil biota of some upland grasslands.

Bardgett, R. D.; Frankland, J. C.; and Whittaker, J. B.

Agriculture, Ecosystems & Environment 45(1-2): 25-45. (1993)

NAL Call #: S601 .A34; ISSN: 0167-8809

Abstract: Soil Collembola, in particular the fungal-feeding *Onychiurus procampatus*, were selected for further study. Field sampling revealed simultaneous trends of decreasing Collembola numbers and increasing total hyphal length and biomass of fungi in the surface soil, together with differences in chemical and physical soil properties, along a gradient of reduced sheep management intensity. Similar changes occurred when sheep grazing was removed by

fenced enclosures. The relative abundance of the seven most commonly isolated species of litter fungi varied along the same gradient of sheep management. -from Authors © 2006 Elsevier B.V. All rights reserved.

38. Effects of animal traffic on soil compaction in wheat pastures.

Krenzer, E. G.; Chee, C. F.; and Stone, J. F. *Journal of Production Agriculture* 2(3): 246-249. (1989)
 NAL Call #: S539.5.J68; ISSN: 0890-8524
Descriptors: Triticum aestivum/ Bos taurus/ conservation tillage/ grazing seasons/ agriculture/ agribusiness/ crop industry/ yield growth/ Great Plains, USA/ bulk density/ gravimetric soil moisture/ soil strength
Abstract: Grazing of hard red winter wheat (*Triticum aestivum* L.) in the U.S. southern Great Plains during the fall and winter, followed in the summer by the harvesting of grain, has been of great economic importance. With the increase in conservation tillage, however, there is growing concern that the compaction effects grazing has on the soil may not be eliminated by subsequent tillage. This study was conducted to quantify the extent to which soil compaction occurs as a result of animal traffic on wheat pasture. Of the three locations that were evaluated in the 1986-1987 growing season, two were on a silt loam soil and the third a sandy loam. Cattle (*Bos taurus*) grazed wheat until the early joint stage of growth, and measurements of soil strength, soil moisture, and bulk density were taken before initiation of grazing and immediately after grazing termination. Bulk density measurements and gravimetric soil moisture evaluations were made at 1.2 in. increments through the soil profile to a depth of 16.5 in. Data for soil strength evaluation, using a mechanical cone penetrometer, were collected at 0.8 in. increments also to a depth of 16.5 in. Increases in both the bulk density and the soil strength of the grazed areas were found in all three sites, although the depth to which the differences were measured varied from site to site. Animal traffic increased bulk density by as much as 16% and soil strength by 270% in surface zones. In the sandy loam soil, the bulk density was increased to a depth of 8 in. and the soil strength to 12 in.; while in the silt loam soils, the bulk density was increased only 5 in. These data indicate that compaction does result from grazing wheat pasture and may extend to a depth where some tillage practices may not eliminate it. The possible effects that this compaction may have on wheat growth and its yield, and the tillage practices necessary to alleviate this compaction require further study.

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39. Effects of cattle grazing and BMPs on stream water quality.

Agouridis, C. T.; Edwards, D. R.; Workman, S. R.; Bicudo, J. R.; Taraba, J. L.; Vanzant, E. S.; and Gates, R. S. In: 2004 ASAE Annual International Meeting. (Held 1 Aug 2004-4 Aug 2004 at Ottawa, Ontario, Canada.); pp. 2251-2277; 2004.
 NAL Call #: S671.3 .A54
Descriptors: bacteria/ best management practices/ nutrients/ stream
Abstract: Cattle production is a major component of Kentucky's agricultural economy, accounting for approximately 15% of the total agricultural sales in 2000. There are over 2.2 million beef cattle and calves in the state

making Kentucky the number one beef producer east of the Mississippi River. Research into the effects of cattle grazing on stream water quality has been well documented in the western portion of the United States with some estimates indicating that 80% of the damage to riparian areas was caused by grazing livestock. However, the impacts of grazing cattle in a humid environment may differ significantly from those witnessed in the arid West. Furthermore, relatively little information exists regarding the effectiveness of grazing best management practices (BMPs), such as alternate water sources, alternate shade sources, supplemental feeding, and riparian buffers, for improving the water quality of streams in grazed watersheds of the humid region. As part of a larger research endeavor into cattle production practices in the humid region, water samples were collected over a two year period at the project site located on the University of Kentucky's Animal Research Center. The project sites consisted of two replications of three treatments: control, selected BMPs with free access to the stream, and selected BMPs with limited access to the stream. Grab samples were collected at the upstream and downstream pasture edges. Samples were analyzed for nitrate-nitrogen, ammonium-nitrogen, total Kjeldahl nitrogen, dissolved orthophosphate, total phosphorus, total suspended solids, pH, chemical oxygen demand, five-day biochemical oxygen demand, fecal coliforms, and fecal streptococci. Results indicated that minimal water quality benefits were incurred by implementing the BMP systems (i.e. treatments). One of the most substantial understandings gleaned from the project was the importance of upstream land use, and to some degree soils, when attempting to identify significant treatment effects within a small reach. Additionally, the karst geology, which is characteristic of the Bluegrass Region of Kentucky, influenced the rate of transport (i.e. flashy system with quick response time to rainfall) of nutrients from upland areas (i.e. row crops), especially along Pin Oak. These external factors may have resulted in the lack of uniformity in significant constituent concentration differences between the two streams when cattle were present. Furthermore, the background constituent concentration levels may have prohibited the identification of treatment effects. Results from this project indicated that minimal water quality benefits were incurred by implementing a BMP system (with or without a partially excluded riparian zone). However, these results may differ if cattle were completely excluded from the stream or if the BMP system was implemented at a site with larger pastures, different geology (nonkarst), soils (low in phosphorus), or stream morphology (nonbedrock bottom channel).

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40. Effects of cattle treading and natural amelioration on soil physical properties and pasture under dairy farming in Southland, New Zealand.

Drewry, J. J. and Paton, R. J. *New Zealand Journal of Agricultural Research* 43(3): 377-386. (2000)
 NAL Call #: 23 N4892; ISSN: 0028-8233
Descriptors: air permeability/ cattle/ compaction/ hydraulic conductivity/ macropores/ pugging/ treading
Abstract: The effects of current dairy cow grazing practice, reduced levels of grazing, and stock exclusion on soil physical properties and pasture dry matter production were

investigated under dairy farming in Southland. Current grazing practice involves rotational grazing with dairy cows from September to May each year, with no grazing during winter. For the reduced grazing treatments, cattle were excluded during the 3rd, or combined 3rd, 4th, and 5th grazing cycles, or for half-day grazing intervals to reduce grazing intensity. Macroporosity increased by 70% in the ungrazed treatment compared with current grazing practice (control) within four months of dairy cow exclusion. Air permeability was increased by over two orders of magnitude 18 months after trial commencement, and saturated hydraulic conductivity increased by 200% to the 10-cm soil depth. Macroporosity, air permeability, and hydraulic conductivity for the reduced grazing treatments were intermediate between the control and ungrazed treatments. Relationships between macroporosity and pasture relative yield are presented. At 97% relative pasture yield, the level of macroporosity was 11.5-11.7% (v/v) in three silt loams.

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41. Effects of exclosure and management on biomass and soil nutrient pools in seasonally dry high country, New Zealand.

McIntosh, Peter D.; Allen, Ralph B.; and Scott, Neal
Journal of Environmental Management 51(2): 169-186. (1997)

NAL Call #: HC75.E5J6; ISSN: 0301-4797

Descriptors: benmore range/ calcium/ carbon/ conservation/ fertilization/ grazing/ magnesium/ nitrogen/ nutrient/ nutrient pools/ phosphorus/ potassium/ rainfall/ root biomass/ soil acidification/ soil quality/ South Island/ sustainable pastoral use/ tussock grasslands

Abstract: We examined the effects of grazing and three exclosure treatments (no grazing, no-grazing plus oversowing, and no grazing plus oversowing plus fertilizer) on soils (Ustochrepts) and biomass of tussock grasslands on hill country under a mean annual rainfall of about 500-600 mm in the Benmore Range, South Island, New Zealand. Excluding grazing by sheep and rabbits for 15 years, with no oversowing or fertilizer, resulted in a two- to three-fold increase in the total biomass (roots+litter+herbage) relative to the grazed treatment. On all three exclosure treatments root biomass was approximately doubled in relation to root biomass on the grazed treatment. With the exception of Mg, total nutrient pools in biomass plus soil were lowest in the grazed treatment. Oversowing alone, without added fertilizer, maintained soil pH at pre-exclosure values and prevented exchangeable Ca, Mg and K decline, but had no significant effect on soil C, N or P. In contrast, oversowing and fertilizing had the effect of increasing soil C and N by 5.7 t/ha and 0.6 t/ha respectively, relative to the ungrazed treatment, and by 8.7 t/ha and 0.87 t/ha respectively, relative to the grazed treatment. Under ungrazed, grazed, and the oversown +fertilizer treatments pH declined relative to pre-exclosure values and values on the oversown treatment. The lower pH under the oversown +fertilizer treatment was attributed to the direct and indirect acidifying effects of elemental S fertilizer, while the lower pH of the ungrazed treatment was attributed, in part, to the acidifying effect of *Hieracium pilosella*, with both cation removal by animals and *Hieracium* effects likely to have lowered pH in the grazed treatment. A positive balance of 425 kg/ha of Ca, 680 kg/ha of K and 1900 kg/ha of N remained in total

biomass plus soil on the oversown +fertilizer treatment, after fertilizer additions and previous herbage removals were taken into account. The positive Ca and K balance was attributed to release of nutrients by soil weathering, and the N balance to N fixation by legumes. Grazing of seasonally dry South Island tussock grasslands on hilly land, even at the present low levels, without fertilizing, appears incompatible with the maintenance of soil pH and carbon and total soil and biomass nutrients.

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42. Effects of grassland management practices and environmental conditions on nutrient concentrations in overland flow.

Kurz, I.; Coxon, C.; Tunney, H.; and Ryan, D.

Journal of Hydrology 304(1-4): 35-50. (2005)

NAL Call #: 292.8 J82; ISSN: 0022-1694

Descriptors: grasslands/ grassland soils/ overland flow/ nitrogen/ phosphorus/ losses from soil/ nonpoint source pollution/ agricultural runoff/ soil fertility/ grazing/ nitrogen fertilizers/ fertilizer application/ Irish Republic

Abstract: The loss of nutrients from agricultural land to water bodies is a serious concern in river basin management in many countries. To gain information on the contributions of agricultural grassland to the eutrophication of water bodies, this study set out to assess phosphorus (P) loss from grassland areas on poorly drained soils. A second aim was to look at the impact of grassland management practices on nutrient concentrations in overland flow. Edge-of-field measurements of overland flow quantity and of P and nitrogen (N) concentrations in overland flow were carried out at three study sites with different soil P levels. The amounts of overland flow and the P concentrations in overland flow varied considerably during events, and among sites and events. Despite this variability, there was a clear increase in P loss in overland flow from the low to the medium and high soil P sites. The inter-site variability of the P concentrations in overland flow greatly exceeded the variability of the amounts of overland flow from the different sites. Thus, P concentrations had a larger impact than the volume of overland flow on the differences in P exports from the three sites. Management practices which, at times, influenced the P and N concentrations in overland flow were grazing and N fertilisation.

This citation is from AGRICOLA.

43. Effects of riparian grazing and channelisation on streams in Southland, New Zealand: Channel form and stability.

Williamson, R. B.; Smith, R. K.; and Quinn, J. M.

New Zealand Journal of Marine and Freshwater Research 26(2): 241-258. (1992)

NAL Call #: QH91.57.A1N4; ISSN: 0028-8330

Descriptors: river banks/ grazing/ erosion/ agriculture/ channels/ vegetation cover/ riparian environments/ geomorphology/ streams/ New Zealand, South I., Southland/ New Zealand/ sheep and cattle grazing/ channelisation/ streams/ vegetation cover

Abstract: The effects of mixed sheep and cattle grazing of stream margins, channelisation, and the benefits of riparian retirement were assessed through a survey of five streams in Southland, New Zealand. There is no evidence that grazing streambanks in floodplain streams of northern Southland will lead to rapid and severe deterioration of channel form, except in small streams (< 2 m wide) under

intensive grazing of wet streamside soils. Generally, the dominant erosion mechanism—the undercutting of banks—is largely unaffected by grazing stream margins. In contrast, channelisation has led to severe streambank and streambed erosion in two of the three streams examined. The major factor in this degradation appears to be straightening and deepening the channel so that underlying uncohesive shingle is exposed to high flows. Riparian retirement had variable effects depending on the stability of the stream channel. On smaller, relatively inactive channels, it reduced localised bank erosion from livestock trampling, especially at cattle crossings. However, this damage (which sometimes can be quite visible) did not lead to significant change in average channel form or width in the 7-15 years since the land has been converted to intensive agriculture from extensively grazed tussock.

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44. Effects of sheep grazing episodes on sediment and nutrient loss in overland flow.

Elliott, A. H. and Carlson, W. T.

Australian Journal of Soil Research 42(2): 213-220. (2004)
NAL Call #: 56.8 Au7; ISSN: 0004-9573

Descriptors: runoff/ sediments/ nutrient loading/ rainfall/ infiltration/ phosphorus/ particulates/ nutrient loss/ growth/ agriculture/ nitrogen/ grasses/ grazing/ nutrients/ overland flow/ infiltration rate/ rainfall simulators/ sheep/ risk/ growth rates/ farms/ pollution load/ baseline studies/ sediment load/ nitrogen compounds/ New Zealand, North I., Waikato/ grazing

Abstract: The effect of sheep grazing on the loss of sediment and nutrients in overland flow was investigated on a hill-country farm in the Waikato, New Zealand. The losses were measured in runoff produced artificially with small (0.5 m super(2)) and large (1050 m super(2)) rainfall simulators. Immediately after intensive winter grazing, rainfall applied at high intensity increased concentrations by a factor of 13-16 for sediment and particulate nutrients, 33-76 for dissolved reactive phosphorus and ammonium-nitrogen, and 5-7 for dissolved organic nitrogen and phosphorus. During summer, when there was less removal of vegetative cover, there was a smaller effect of grazing. The concentrations of sediment and particulate nutrients in overland flow were strongly correlated with the percentage of bare ground. The concentrations returned to background levels within 6 weeks after grazing, and the infiltration rate and ground cover also recovered from grazing in this time. The small rainfall simulator experiments showed that the infiltration rate decreases with grazing, which results in greater runoff after grazing. The greater runoff combines with the increased concentrations to give higher loads after grazing. In late winter, the infiltration rates were approximately half the summer values and the soil erodibility was approximately double, so the risk of high sediment and nutrient loads is greatest in winter, especially considering the higher rainfall and lower grass growth. The management implications are that exposure of bare ground associated with intensive grazing should be avoided, especially in winter.

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45. Effects of soil texture and grassland management on soil organic C and N and rates of C and N mineralization.

Hassink, J.

Soil Biology and Biochemistry 26(9): 1221-1231. (1994)
NAL Call #: S592.7.A1S6; ISSN: 0038-0717

Descriptors: grassland soils/ soil organic matter/ carbon/ nitrogen/ mineralization/ soil texture/ range management/ age/ nitrogen fertilizers/ mowing/ grazing/ carbon nitrogen ratio/ application rate

Abstract: The effects of soil texture and grassland management, i.e. rate of fertilizer N input, mowing vs grazing, and the number of years the site is under grass, on the amounts of soil organic C and N and on the rates of C and N mineralization were investigated. A positive relationship was found between the amount of organic N in the soil and the clay + silt content. The relationship was affected by the groundwater table. There was a negative relationship between the percentage of soil N mineralizing during incubation and the clay + silt content of the soil. The amount of organic C was only positively correlated with soil texture in the soils with a high water table, but the relationship was less clear. Except for the groundwater table, differences in the C-to-N ratio of the soil organic matter in sandy soils confused the relationship of soil organic C with soil texture. Organic matter in podzol soils had C-to-N ratios between 15 and 20 while in other sandy soils the C-to-N ratio ranged from 10 to 18; in loams and clays the C-to-N ratio was ca 10. The percentage of soil C mineralizing in sandy soils was negatively correlated with the C-to-N ratio of the soil organic matter. The sandy soils with a C-to-N ratio > 16 that were used for incubation contained black humus including small charcoal particles; both other sandy soils with a lower C-to-N ratio contained brown humus without visible charcoal particles. So we hypothesize that sandy soils with a high C-to-N ratio contained more inert C than sandy soils with a low C-to-N ratio. The rate of N fertilization had no effect on soil organic C and N nor on the rates of C and N mineralization. Differences between the effects of grazing and mowing on soil organic C and N and the rate of C and N mineralization were very small and not very consistent. Both the amounts of soil organic C and N found and the rates of C and N mineralization were significantly higher in old grassland (10 yr) than in young grassland (1-3 yr). The increases in the mineralization rates were larger than the increases in soil organic C and N.

This citation is from AGRICOLA.

46. Effects of the nitrification inhibitor dicyandiamide on potassium, magnesium and calcium leaching in grazed grassland.

Di, H. J. and Cameron, K. C.

Soil Use and Management 20(1): 2-7. (Mar. 2004)
NAL Call #: S590.S68; ISSN: 0266-0032

This citation is from AGRICOLA.

47. Effects of trampling by cattle on the hydraulic and mechanical properties of soil.

Pietola, L.; Horn, R.; and Yli Halla, M.

Soil and Tillage Research 82(1): 99-108. (2005)
NAL Call #: S590.S48; ISSN: 0167-1987

Descriptors: clay/ deformation/ Entisols/ environmental impact/ grassland soils/ grazing/ hydraulics/ Inceptisols/ infiltration/ macropores/ pastures/ porosity/ runoff/ runoff

water/ sandy loam soils/ soil compaction/ soil mechanics/ soil structure/ soil types/ trampling

Abstract: Destroyed soil structure can increase surface runoff water, with adverse environmental impacts. The effects of trampling by cattle on physical parameters of a heavy clay (a Typic Cryaquept) were studied at the followings four Site types of a pasture after grazing for three seasons: (1) grass with no visible trampling; (2) pasture with some trampling; (3) vicinity of a drinking site with some signs of penetrated hooves, and; (4) a drinking site with totally homogenized surface soil and destroyed vegetation. Additionally, Site types 1 and 4 were studied on sandy loam (an Aquic Cryothent) derived from glacial till after one grazing season. Steady state infiltration rates were reached after 15-35 min of infiltration, depending on the degree of trampling and soil texture. On the sandy loam the infiltration rate at the drinking site was only 20% of that under natural pasture with no visible trampling. When the trampling occurred for longer periods in a soil with higher clay content, the infiltration rate of drinking site was only 10-15% of that in non-trampled pastures. These findings could be explained by a reduced porosity for both soils. In heavy clay at the depth of 10-15 cm, macropores ($O > 30$ micro m) decreased from 5 to 1.5% (v/v) by the most severe trampling and mechanical strength was lost near the soil surface (cohesion ~ 1 kPa). Deeper at 10-13 cm, cohesion (at water potential of -6 kPa) was near 30 kPa at the drinking site but around 20 kPa in non-trampled sites. At the 20-23 cm depth of Site 4, the angle of internal friction value (35) for smaller stresses (< 150 kPa) was reduced to smaller values (9) at greater strengths (150-300 kPa) due to a stress dependent aggregate strength and the conversion of a structured soil system to a mostly texture dependent one. The data showed that even a low intensity of grazing will reduce infiltration and hence increase susceptibility to erosion at the drinking sites.

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48. The efficacy of controlling phosphorus loading: The case of management-intensive grazing.

Winsten, J. R. and Stokes, J. R.

Agricultural Systems 79(3): 283-303. (Mar. 2004)

NAL Call #: HD1.A3; ISSN: 0308-521X

Abstract: Consolidation in US agriculture has led to fewer, larger farms. In the case of dairy in the Northeastern US, higher concentrations of animals near large population centers pose water quality problems that can be attributed to excessive soil nutrient levels. While new environmental policies and regulations are being developed and implemented to help manage such problems, research to determine the efficacy of alternative dairy production systems is needed. The research reported in this paper makes use of stochastic dynamic programming to determine optimal stocking densities, milk production levels, and feed rations for a hypothetical dairy farm using management-intensive grazing. A key feature of the model is that financial disincentives are placed on excessive accumulation of phosphorus in the farm's soils. The results show that under optimal management the cost of reducing soil phosphorus to acceptable levels across all states of nature modeled is approximately \$524 per hectare per year. The optimal farm management strategy is to rapidly

reduce the size of the dairy herd (as opposed to feeding for a lower level of milk production per cow) until soil phosphorus levels are under control.

This citation is from AGRICOLA.

49. Emission of nitrous oxide from some grazed pasture soils in New Zealand.

Carran, R. A.; Theobald, P. W.; and Evans, J. P.

Australian Journal of Soil Research 33(2): 341-352. (1995)

NAL Call #: 56.8 Au7; ISSN: 0004-9573

Descriptors: grazing/ grassland soils/ trampling/ nitrogen/ nitrous oxide/ emission/ soil/ grasslands/ pastures

Abstract: Nitrous oxide emissions from grazed pastures were measured at four sites in North Island, New Zealand, for a 2 year period. Sites differed in drainage class and N cycle characteristics. At two intensively farmed sites on Kairanga silt loam, which is poorly drained, daily emissions ranged from 0 to 100 g N/ha per day and annual emission was in the range 3-5 kg N₂O-N/ha. Emissions occurred when the soil was near or above field capacity indicating denitrification was the probable source of N₂O. Multiple regression analysis, using soil water content, NO₃⁻, NH₄⁺ and temperature, gave $r^2 = 0.44$ and 0.57 at sites 1 and 2 respectively. Soil water content and NH₄⁺ were significant variables. Emissions at a low fertility hillside site were low and an annual emission of 0.5 kg/N₂O-N per yr, or less, was indicated. The highly fertile hillside site showed low emission values. It is suggested that grazing animals may have a significant impact on emissions through hoof damage on wet soils.

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50. The environmental impact of nitrogen fertiliser use on dairy pastures.

Eckard, R. J.; Chapman, D. F.; White, R. E.; and Chen, D.

Australian Journal of Dairy Technology 59(2):

145-148. (2004)

NAL Call #: 44.8 Au74; ISSN: 0004-9433

Descriptors: nitrogen abatement management: applied and field techniques/ climatic factors/ denitrification/ grazed dairy pasture/ seasonal variation/ volatilisation loss

Abstract: The use of fertiliser nitrogen (N) on dairy pastures in southeastern Australia has increased exponentially over the past 20 years, with more than 60% of dairy farmers applying between 25 and 50 kg N/ha at least once a year (Eckard and Franks 1998; Eckard et al. 2000). This increase in N use is of environmental concern due to the gaseous losses of NH₃ and N₂O and the leaching of NO₃. Over the past 10 years, there has been an estimated 140% increase in N₂O emissions from agricultural systems in Australia (AGO 2003). The application of both N fertiliser and urinary N to intensively grazed pasture can contribute to significant losses of NO₃ during periods of high rainfall and drainage (Cameron and Scotter 1987). Few data are available quantifying N losses from intensive pasture-based dairy production systems in south-eastern Australia (Eckard 1998). This paper reviews the recent data of Eckard et al. (2003) and Eckard et al. (2004) reporting N losses through gaseous and leaching pathways from grazed dairy pastures, respectively, and proposes abatement management practices.

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51. Erosional effects of cattle on streambanks in Tennessee, U.S.A.

Trimble, S. W.

Earth Surface Processes and Landforms 19(5): 451-464. (1994)

NAL Call #: GB400.E2; ISSN: 0197-9337

Descriptors: bank erosion/ streams/ geomorphology/ livestock/ watershed management/ riparian vegetation/ agriculture/ grazing/ soil erosion/ river banks/ environmental impact/ vegetation cover/ ecosystem disturbance/ USA, Tennessee

Abstract: The geomorphological effects of cattle on streambanks in a humid region, which have consequent potential effects on water quality, are examined. Field observations suggest that cattle are important agents in causing streambanks to erode, but so many variables are involved that it is difficult to isolate the role of cattle. Instead, an empirical approach based on long-term controlled experiment was adopted along a small perennial stream in the central basin of Tennessee. The results showed that uncontrolled grazing caused about six times as much gross bank erosion as occurred on the protected control stretch. However, most of this difference was due to breakdown of banks by trampling and consequent erosion, rather than by bank scour caused by removal of bank vegetation by grazing. That is, bank vegetation alone did not appear to be a primary control. A relatively inexpensive grade-control structure reduced the gross bank erosion by about 50 per cent. The rapid destruction of streambanks observed in this study suggests that reduction of geomorphic resistance by uncontrolled stock access to streambanks has been an important factor in the stream widening that has taken place during historical time in the eastern United States.

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52. Evaluation of soil compaction in an irrigated short-duration grazing system.

Silva, A. P.; Imhoff, S.; and Corsi, M.

Soil and Tillage Research 70(1): 83-90. (2003)

NAL Call #: S590.S48; ISSN: 0167-1987

Descriptors: grazing/ grazing intensity/ grazing systems/ irrigation/ pastures/ resistance to penetration/ rotational grazing/ soil compaction/ soil degradation/ soil fertility/ soil physical properties/ soil water content/ stocking rate/ trampling

Abstract: Reduction in pasture productivity is generally attributed to alterations in soil quality. Soil compaction due to animal trampling is one of the factors responsible for the degradation of the physical quality of soils under pasture. The objective of the study was to evaluate penetrometer resistance (PR) in an irrigated short-duration grazing system at three post-graze residue levels. PR and moisture were simultaneously measured in plots containing three different post-graze residue levels (1000, 2500 and 4000 kg dry material ha⁻¹). The influence of soil moisture on PR was taken into account using regression analysis techniques. PR was significantly higher for the treatments characterized by a small amount of post-graze residue, while similar values were obtained for the other two treatments. From a management perspective, adopting an irrigated short-duration grazing system with high stocking rate may adversely affect the soil physical quality.

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53. Faecal contamination over flood events in a pastoral agricultural stream in New Zealand.

Nagels, J. W.; Davies-Colley, R. J.; Donnison, A. M.; and Muirhead, R. W.

Water Science and Technology 45(12): 45-52. (2002)

NAL Call #: TD420.A1P7; ISSN: 0273-1223.

Notes: Conference: 5. International Symposium on Waste Management Problems in Agro-Industries, Shiga [Japan], 16-18 Nov 2001

ISBN: 1843394197

Descriptors: water pollution sources/ nonpoint pollution sources/ agricultural watersheds/ livestock/ flood flow/ bacterial analysis/ Escherichia coli/ experimental data/ data collections/ model studies/ streams/ fecal coliforms/ floods/ pollution (water)/ pollution (nonpoint sources)/ catchment areas/ livestock (see also individual animals)/ floods and flooding/ microbiological analysis/ bacteria (Enterobacteriaceae) (Escherichia) Escherichia coli/ New Zealand/ New Zealand, Morrinsville/ cattle

Abstract: Faecal bacterial dynamics during flood events were studied in the Topehaehae Stream near Morrinsville, New Zealand, in a catchment used for grazing dairy and beef cattle. During the rising limb of a natural flood event, E. coli bacterial concentration rose by more than 2 orders of magnitude and peaked at 41,000 cfu/100 mL. E. coli correlated closely with turbidity over the flood event, and both variables peaked close to the time of maximum flow acceleration rather than peak flow. An artificial flood on the same stream, created by releasing water from a supply reservoir during fine weather with no wash-in from the catchment, produced a broadly similar pattern of faecal contamination (peak E. coli = 12,500 cfu/100 mL). This and other evidence suggests that direct deposition of faecal matter by cattle in the stream channel may be of similar or greater importance than wash-in from land. The flood experiments have been useful for constructing a model of faecal bacterial yields, and they imply that exclusion of livestock from stream channels may appreciably improve water quality.

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54. Faecal bacteria in agricultural waters of the bluegrass region of Kentucky.

Howell, J. M.; Coyne, M. S.; and Cornelius, P.

Journal of Environmental Quality 24(3): 411-419. (1995)

NAL Call #: QH540.J6; ISSN: 0047-2425

Descriptors: karst/ cattle/ groundwater pollution/ coliforms/ feces/ Streptococcus/ agricultural runoff/ sampling/ nonpoint pollution sources/ surface-groundwater relations/ animal wastes/ livestock/ water pollution/ water supply/ fecal microflora/ fecal coliforms/ ground water/ agricultural pollution/ microbial contamination/ hazard assessment/ Enterococcus/ USA, Kentucky/ FC/ FS/ USEPA

Abstract: Agricultural runoff influenced by nonpoint pollution frequently exceeds the USEPA standards for bacterial contamination of primary contact water (200 fecal coliforms/100 mL). Few studies have evaluated the effect of cattle (*Bos taurus*) grazing on fecal contamination of groundwater in the karst topography of central Kentucky. Our objectives were to: (i) observe the extent and pattern of fecal bacteria in agricultural waters from two central Kentucky watersheds; (ii) determine if monthly sampling accurately assessed the extent and variability of fecal contamination; and (iii) assess the fecal coliform/fecal streptococci ratio (FC/FS) as an indicator of fecal bacteria

source. Springs, streams, and wells in two agricultural watersheds typical of central Kentucky were monitored for fecal coliform and fecal streptococci from December 1991 to January 1993. Springs and wells exceeded primary contact water standards, between 28 and 74% of the time; streams exceeded water quality standards between 87 and 100% of the time. When fecal bacteria were present, rainfall rapidly moved them from the soil surface into spring and well water. At two springs in Fleming county, only 29% of samples exceeded primary contact standards before cattle were present; 80% exceeded standards after cattle began grazing the surrounding pasture. Monthly sampling adequately reflected the extent of fecal contamination in our study, which had relatively continuous cattle grazing. Although the FC/FS ratio identified domestic animal contamination sources, it did not distinguish between domestic animal and human sources of contamination.
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55. Fecal coliform and streptococcus concentrations in runoff from grazed pastures in northwest Arkansas.

Edwards, D. R.; Coyne, M. S.; Vendrell, P. F.; Daniel, T. C.; Moore, P. A.; and Murdoch, J. F.

Water Resources Bulletin 33(2): 413-422. (1997)

NAL Call #: 292.9 Am34; ISSN: 0043-1370

Descriptors: agricultural runoff/ cattle/ coliforms/ Streptococcus/ pastures/ manure/ water quality standards/ grazing/ seasonal variations/ agricultural practices/ fecal coliforms/ fecal microflora/ pasture/ USA, Arkansas, Northwest

Abstract: Agricultural practices such as cattle grazing and animal manure application can contribute to relatively high runoff concentrations of fecal coliform (FC) and fecal streptococcus (FS). Available information, however, is inconsistent with respect to the effects of such practices as well as to measures that can discriminate among candidate sources of FC and FS. The objective of this study was to assess the effects of grazing, time of year, and runoff amounts on FC and FS concentrations and to evaluate whether FC/FS concentration ratios are consistent with earlier values reported as characteristic of animal sources. Runoff from four Northwest Arkansas fields was sampled and analyzed for fecal coliform (FC) and fecal streptococcus (FS) for nearly three years (1991-1994). Each field was grazed and fertilized, with two fields receiving inorganic fertilizer and two receiving animal manure. Runoff amount had no effect on runoff concentrations of FC or FS. There were no consistent relationships between the presence of cattle and FC and FS runoff concentrations. Both FC and FS concentrations were affected by the season during which the runoff occurred. Higher concentrations were observed during warmer months. Runoff FC concentrations exceeded the primary contact standard of 200 cfu/100 mL during at least 89 percent of all runoff events and the secondary contact standard of 1000 cfu/100 mL during at least 70 percent of the events. Ratios of FC to FS concentrations varied widely (from near zero to more than 100), confirming earlier findings that FC/FS ratios are not a reliable indicator of the source of FC and FS.
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56. Fecal contamination of pastoral wetlands.

Collins, R.

Journal of Environmental Quality 33(5): 1912-1918. (2004)

NAL Call #: QH540.J6; ISSN: 0047-2425

Descriptors: wetlands/ cattle/ solar radiation/ contamination/ bacterial/ grazing/ bacteria (enterobacteriaceae) (escherichia)/ catchment areas/ storms/ temperature/ rainfall/ high flow/ excretion/ statistical models/ storm seepage/ feces/ survival/ water quality control/ livestock/ water quality/ catchments/ seasonal variations/ mathematical models/ environmental quality/ Escherichia coli/ New Zealand

Abstract: Near-channel hill-country wetlands draining steep pastoral land in New Zealand exhibit high levels of fecal contamination at a range of flows. This contamination is attributed to both the transport of bacteria into a wetland from the surrounding catchment and the direct excretion of fecal material onto wetlands by grazing cattle. E. coli concentrations observed at low to moderate flow at 20 sites varied between 0.5×10^1 and 2×10^4 most probable number (MPN) 100 mL⁻¹. High flow concentrations measured at two wetlands ranged up to 6×10^6 MPN 100 mL⁻¹ and yielded storm period bacterial loads of between 1×10^6 and 3×10^{10} MPN per event. Given the disproportionately large fraction of surface and subsurface flow from the catchment that passes through the wetlands, these yields represent a large proportion of the total loss of bacteria from steep grazed hillsides, across a range of storm events. Cattle are attracted to the smaller, shallower wetlands for grazing in both summer and winter. Excluding stock from shallow wetlands may therefore yield improvements in bacterial water quality, although accurately quantifying this improvement is difficult without long-term studies. Cattle are not attracted to larger, deeper wetlands, presumably for fear of entrapment, and fencing them is unlikely to realize significant improvements in bacterial water quality. A statistical model incorporating solar radiation and flow explains 87% of the variance in E. coli concentrations across five monitored rainfall events. A positive correlation was found between solar radiation and E. coli concentration. The study was conducted in winter when clear, sunny days are relatively cold. Solar radiation on these days appears to be too weak to promote die-off but the colder temperatures aid survival.
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57. Fertilisers and phosphorus loss from productive grazing systems.

Nash, David M. and Halliwell, David J.

Australian Journal of Soil Research 37(3): 403-429. (1999)

NAL Call #: 56.8 Au7; ISSN: 0004-9573

Descriptors: fertilizer management/ productive grazing systems

Abstract: This paper reviews phosphorus loss from productive high rainfall grazing systems. In particular it describes the processes occurring when phosphatic fertilisers are added to soil, the different pathways through which fertiliser and other nutrient sources may contribute to phosphorus losses, and an evaluation of the management strategies aimed at minimising phosphorus loss. It is now generally accepted that soil is not an endless sink for phosphorus uptake and that at the landscape scale the highest concentrations of phosphorus loss occur in surface runoff, followed by macropore flow and vertical matrix flow.

However, loads of phosphorus lost through these pathways are unknown. The development of an understanding of the transport mechanisms and phosphorus species being transported is fundamental to developing management strategies that are effective in decreasing phosphorus losses from grazing systems.

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58. Grassland management effects on soil surface properties in the Ozark Highlands.

Brye, K. R. and West, C. P.

Soil Science 170(1): 63-73. (Jan. 2005)

NAL Call #: 56.8 So3; ISSN: 0038-075X

Descriptors: grassland soils/ grasslands/ silt loam soils/ grazing/ mowing/ bulk density/ soil pH/ soil chemistry/ exchangeable cations/ prairies/ pastures/ surface layers/ soil fertility/ soil nutrients/ Arkansas

This citation is from AGRICOLA.

59. Grazing management affects soil phosphorus and potassium levels.

Gerrish, J. R.; Peterson, P. R.; and Brown, J. R.

American Forage and Grassland Council Proceedings 4: 175-179. (1995)

NAL Call #: SB193.F59

This citation is from AGRICOLA.

60. Grazing systems to maximize forage and minimize P, N, and sediment pollution of streams.

Russell, Jim; Haan, Matthew M.; Powers, Wendy; Schultz, Richard; Mickelson, Steve; Ahmed, S.; and Kovar, John.

In: *Proceedings: Agriculture and the Environment: The Challenge of Change*. (Held 4 Mar 2002-6 Mar 2002 at Ames, Iowa.)

http://www.ans.iastate.edu/faculty/wpowers/acc/pub/Systems_to_maximize_forage_and_minimize.pdf

Descriptors: sediments/ agricultural runoff/ phosphorus/ pastures/ grazing management

61. Headwater stream response to grassland agricultural development in New Zealand.

Riley, R. H.; Townsend, C. R.; Niyogi, D. K.; Arbuttle, C. A.; and Peacock, K. A.

New Zealand Journal of Marine and Freshwater Research 37(2): 389-403. (2003)

NAL Call #: QH91.57.A1N4; ISSN: 0028-8330

Descriptors: biological diversity/ community composition/ food webs/ streams/ agricultural land/ land use/ grasslands/ man-induced effects/ agriculture/ agricultural runoff/ nutrients (mineral)/ environmental impact/ rivers/ chemical limnology/ ecosystem disturbance/ aquatic organisms/ zoobenthos/ aquatic plants/ vegetation cover/ grain size/ sediments/ Invertebrata/ New Zealand

Abstract: Agricultural development of native grasslands may change stream physico-chemistry in ways that provide both subsidies and stresses to the system. The aims of this study were to determine: (1) which physico-chemical parameters respond most strongly to agricultural development; (2) how biodiversity, community composition, and food-web structure responded to these changes; and (3) to determine the balance between negative and positive impacts of these subsidies and stresses based on the analysis of 18 headwater streams. Developed pasture streams had increased nutrient loading, alterations to streamside vegetation, increased fine sediment

composition, and lower moss coverage of streambeds than undeveloped or lightly grazed native grassland catchments (which could not be distinguished from one another). These differences were associated with higher numbers of macroinvertebrate taxa and higher numbers of macroinvertebrates indicating that the net effects of these subsidies and stresses associated with agricultural development were positive within these headwater stream reaches.

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62. Hydrology and soil loss from a high fertility rotational pasture program.

Owens, L. B.; Van Keuren, R. W.; and Edwards, W. M.

Journal of Environmental Quality 12(3): 341-346. (1983)

NAL Call #: QH540.J6; ISSN: 0047-2425

Descriptors: Dactylis glomerata/ Festuca arundinacea/ beef management program/ Ohio/ USA/ watershed/ grazing/ feeding/ hay/ surface runoff/ H flume/ Coshocton wheel

Abstract: Five small watersheds (0.25-3.1 ha) on sloping uplands in eastern Ohio [USA] were used to evaluate environmental effects of a beef management program of rotational summer grazing on one area, and rotational winter grazing/feeding with stored hay on another area. During the 5-yr study, annual precipitation was 1080 mm, which was 8-15% greater than the long-term average. The surface runoff was measured by precalibrated H-flumes, and automatically sampled using Coshocton wheels. Surface runoff from watersheds with beef cattle management increased, compared with the long-term averages when hay was grown on the watersheds. Greater precipitation was the primary factor causing more runoff during the growing season (May-Oct), and the cattle management was a major contributing influence on the runoff increase during the dormant season (Nov.-April). Maintenance of good vegetative cover [Dactylis glomerata, Festuca Arundinacea] on the study areas was a major factor in limiting annual average surface runoff to < 110 mm, which was a relatively small amount. The large runoff events, although a small percentage of the total number of events, produced most of the runoff volume. Soil loss from these pastures was minimal.

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63. Hydromorphological and biological factors influencing sediment and phosphorus loss via bank erosion in small lowland rural streams in Denmark.

Laubel, A.; Kronvang, B.; Hald, A. B.; and Jensen, C.

Hydrological Processes 17(17): 3443-3463. (2003)

NAL Call #: GB651.H93; ISSN: 0885-6087

Descriptors: bank erosion/ suspended sediments/ streams/ phosphorus/ catchment areas/ topsoil/ vegetation/ hydrologic models/ stream banks/ soil erosion/ catchment area/ spatial variations/ resuspended sediments/ agricultural runoff/ vegetation cover/ sediments/ agriculture/ river banks/ Denmark

Abstract: Bank erosion was measured at 91 stream banks located in 15 Danish rural 1st and 2nd order streams over a 2-year period. Our aims were firstly to examine factors controlling spatial variation in bank erosion, secondly to estimate sediment and phosphorus (P) loss via bank erosion. The overall mean bank erosion rate was 11 mm year super(-1). Bank erosion rate over the 2-year period was significantly related to a number of site-specific

characteristics, including bank angle, bank vegetation cover, overhanging bank and estimated stream power. An empirical model for bank erosion based on these descriptive variables yielded a 55% explanation of the observed spatial variation in bank erosion rate. Bank erosion was higher at the lower 50-cm bank section (20 mm year super(-1)) than at the upper bank (6 mm year super(-1)). Cattle fencing in grazed areas and buffer zones with riparian woodland lowered bank erosion rates. We found that total P content of bank material was high (0.64 g P kg super(-1)) and at the same level as found in agricultural topsoil along the streams. The overall annual catchment loss of bank-derived clay-silt sediment and total P to streams amounted to 58-72 kg sediment ha super(-1) and 0.23-0.28 kg P ha super(-1), respectively. In comparison, the mean annual suspended sediment (SS) and total P losses from 14 similar sized Danish agricultural catchments were 122 kg SS ha super(-1) and 0.58 kg P ha super(-1) over the 2-year study period. Thus, bank erosion seems to be a major contributor of suspended sediment and P in this type of small channelized lowland stream.

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64. Impact of cattle treading on hill land: Soil damage patterns and pasture status.

Sheath, G. W. and Carlson, W. T.

New Zealand Journal of Agricultural Research 41(2): 271-278. (1998)

NAL Call #: 23 N4892; ISSN: 0028-8233

Descriptors: cattle/ grazing management/ hill land/ sustainability/ treading

Abstract: An experiment was conducted on steep hill land in New Zealand to describe the pattern of cattle treading that occurred from a single damage event during winter. The experiment also measured some of the consequences of treading and sought to define the subsequent grazing management which promoted the most rapid recovery of pasture. In hill paddocks of mixed topography, damage of the soil surface was greatest on animal tracks/camps and easy contoured areas (<25°) where cattle prefer to walk. Evidence of this initial winter impact disappeared over spring, most rapidly on easy contoured areas and under continuous sheep grazing. To promote rapid recovery of damaged paddocks continued grazing of cattle during spring should be avoided. At high levels of damage (>50% soil surface), puddling on tracks/camps and skid damage on steep inter-tracks became frequent. These processes are significant because animal tracks/camps act as important channels for surface water flow in hill lands; and disturbed, inter-track areas are an important source of sediment runoff. During spring, pasture growth rates were reduced by treading damage. From a systems context this could represent losses of 5-10 kg DM ha⁻¹ d⁻¹ during early-mid spring. Pasture cover and growth rates had fully recovered by early December.

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65. Impact of cattle treading on hill land: Soil physical properties and contaminant runoff.

Nguyen, M. L.; Sheath, G. W.; Smith, C. M.; and Cooper, A. B.

New Zealand Journal of Agricultural Research 41(2): 279-290. (1998)

NAL Call #: 23 N4892; ISSN: 0028-8233

Descriptors: cattle/ livestock/ soil erosion/ infiltration/

density/ soil porosity/ contamination/ soil physical properties/ runoff/ rainfall/ agriculture/ soil/ physicochemical properties/ simulation

Abstract: A simulated rainfall study carried out as part of a larger grazing experiment was conducted to investigate the effects of a 2-3 day cattle-treading event in winter on soil physical properties and contaminant (sediment and nutrient) runoff in topographically variable hill land. Measurements were made on two land zones: easy contoured ridges and gullies (15-24 degree slope) and steep inter-track land (28-39 degree slope). Simulated rainfall was applied to 16 plots (0.5 m super(2)) with a range of treading damage for each land zone within 14 days of the treading event. Simulated rainfall was repeated on the same plots in the following summer and winter to assess the recovery of soil from treading damage. Treading damage reduced water infiltration rate, particularly in the steep zone. It also caused a significant increase in the transport of suspended solids (SS), total Kjeldahl nitrogen (TKN), and total phosphorus (TP) from the plots during simulated runoff. On the steep inter-track zone, damaged areas had a 46% lower infiltration rate, and runoff from these areas contained on average 87% more sediment, and 89% more N and 94% more P compared with undamaged areas. These effects had disappeared six months later. The rainfall simulation and soil physical studies show that a 2-3 day winter treading event may increase soil bulk density, reduce soil macroporosity and total porosity, and lead to a decrease in the water infiltration rate and an increase in contaminant runoff.

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66. Impact of excreted nitrogen by grazing cattle on nitrate leaching.

Hack-ten Broeke, M. J. D.; Groot, W. J. M. de.; and Dijkstra, J. P.

Soil Use and Management 12(4): 190-198. (1996)

NAL Call #: S590.S68; ISSN: 0266-0032

Descriptors: cattle/ grazing/ excreta/ nitrogen/ losses from soil/ nitrates/ leaching/ nitrate nitrogen/ nitrogen content/ spatial distribution/ soil water/ simulation models/ grassland soils/ sandy soils/ soil water content/ soil heterogeneity/ unsaturated flow/ water pollution/ drinking water/ health hazards/ Netherlands

Abstract: At De Marke experimental farm, data on water and nitrogen flows in the unsaturated zone were gathered on two grazed pastures on sandy soils during the years 1991 to 1994. These provided a basis for calibration and validation of simulation models. The different levels of nitrate-N concentrations of the two plots could largely be explained by differences in crop uptake and simulated denitrification as influenced by different groundwater levels. The irregular distribution of excreta was taken into account by a simulation study quantifying the variability of nitrate-N concentrations under a grazed field. The resulting distribution of simulated nitrate-N concentrations explained the average and peak values of the measured concentrations. Temporal variability of weather was used to assess the nitrate leaching risk under urine patches deposited in either July or September. At site A the probability of exceeding the EC-directive by drinking water (11.3 mg/l nitrate-N) under a urination deposited in either July or September was respectively 10 and 25%. The average field concentration at this site will hardly ever be a high risk for the environment under the current farm

management. At site B the EC-directive will be exceeded under any urine patch in almost 100% of the years, affecting the field average concentration. In field B careful grazing management would result in less nitrate leaching, but the environmental goals would not be reached. This citation is from AGRICOLA.

67. Impact of grazing management on soil nitrogen, phosphorus, potassium, and sulfur distribution.

Mathews, B. W.; Sollenberger, L. E.; Nair, V. D.; and Staples, C. R.
Journal of Environmental Quality 23(5): 1006-1013. (1994)
NAL Call #: QH540.J6; ISSN: 0047-2425

Descriptors: range management/ Cynodon dactylon/ rotational grazing/ soil fertility/ nitrogen/ phosphorus/ potassium/ sulfur/ soil pH/ drainage water/ water quality/ soil horizons

Abstract: Little information is available directly comparing soil nutrient distribution under different defoliation managements. During 1990 (116 d) and 1991 (141 d), 'Callie' bermudagrass (*Cynodon dactylon* var. *aridus* Harlan et de Wet) pastures grazed by Holstein heifers (*Bos taurus*) were used to determine the effects of two rotational stocking methods and continuous stocking on lateral and vertical distribution of extractable N, P, K, and S. A hay management also was included to compare soil responses under grazing and clipping. Nutrient distribution and concentration in the Ap1 horizon (0- to 15-cm soil depth) did not differ among grazing methods, but N, P, and K accumulated in the third of the pastures closest to shade, water sources, and supplement feeders (lounging areas where cattle tend to congregate or rest). Similar observations were made with K in the Ap2 horizon (15- to 30 cm soil depth). Nutrient concentrations were lower or tended to be lower in the Ap1 horizon of the hay management than in grazed pastures because of nutrient removal in harvested herbage. Across defoliation managements, greater extractable N, P, and K concentrations were observed in the Ap1 horizon in 1991 than in 1990. For N and K, this was attributed to fertilizer inputs in all managements and partially to supplemental feed inputs in d pastures. Increases in extractable P appeared to be associated primarily with flooding of the experimental site in late 1991. This study suggests that grazing method of well-managed pastures may have little effect on short-term (2 yr) soil nutrient distribution, especially when grazing occurs during months when temperatures are high.

This citation is from AGRICOLA.

68. The impact of increasing the length of the cattle grazing season on emissions of ammonia and nitrous oxide and on nitrate leaching in England and Wales.

Webb, J.; Anthony, S. G.; Brown, L.; Lyons Visser, H.; Ross, C.; Cottrill, B.; and Scholefield, D.
Agriculture, Ecosystems & Environment 105(1-2): 307-321. (2005)

NAL Call #: S601 .A34; ISSN: 0167-8809
Descriptors: ngauge model: mathematical and computer techniques/ ammonia emission model: mathematical and computer techniques/ grazing season extension model: mathematical and computer techniques/ manure nitrogen evaluation routine model: manner model, mathematical and computer techniques/ cattle grazing season

Abstract: Ammonia (NH₃) emissions from cattle are much

less when they are grazing than when they are housed. The urine excreted during grazing may rapidly infiltrate soil whereas it remains on the surface of impermeable floors and yards. If the average grazing season for the UK herd could be extended from 6 to 8 months, NH₃ emissions from cattle could potentially be reduced by ca. 15% (of the total for all livestock) if the cattle spend all of the extra grazing days outdoors. The main objective of this desk study was to assess the potential of extended season grazing to reduce NH₃ emissions from UK cattle farming. The impacts on nitrate (NO₃⁻) leaching and nitrous oxide (N₂O) emissions were also estimated. A simple process-based model was developed to quantify the potential for extending the grazing season. A farm-scale model of NH₃ emissions at the farm-scale, based on published emission factors for UK agriculture, was used to estimate NH₃ emissions. Losses of NO₃⁻ following slurry spreading were estimated using the MANNER model, while NO₃⁻ leaching and denitrification losses during grazing were taken from output by the NGAUGE model. We conclude that one month's extra grazing (based on the animals being outside for all of that month, day and night) may reduce NH₃ emissions from slurry-based systems by ca. 9% and for FYM-based systems by ca. 7% compared with losses from the current ca. 180-day winter housing period. However, in practice cattle are not outdoors all day during the extended grazing period. If it is assumed that cattle graze for an average of 4 h per day over the extended period, then the monthly reduction in NH₃ emissions may be only ca. 1-2%. At all sites most of this conserved N was predicted to be lost as NO₃⁻. For slurry-based systems this could be at least 80%. For FYM-based leaching was always greater than the NH₃ systems. For which there was less potential to conserve NH₃, the increase in NO₃⁻ conserved. The effects on direct emissions of N₂O were estimated to be negligible, if grazing began earlier in spring or perhaps some reduction when grazing continues for longer in autumn. We conclude that extending the grazing season will increase - leaching and that further studies are needed to fully evaluate the potential for reducing emissions of NH₃. Copyright 2004 Elsevier B.V. All rights reserved.

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69. Impact of land use on the faecal microbial quality of hill-country streams.

Donnison, A.; Ross, C.; and Thorrold, B.
New Zealand Journal of Marine and Freshwater Research 38(5): 845-855. (2004)
NAL Call #: QH91.57.A1N4; ISSN: 0028-8330

Descriptors: streams/ forests/ land use/ water pollution/ pollution indicators/ seasonal variations/ recreation/ freshwater environments/ sampling/ public health/ biological pollutants/ microbial contamination/ pathogenic bacteria/ environment management/ stream flow/ agriculture/ recreational waters/ rivers/ *Escherichia coli*/ *Pinus radiata*/ New Zealand, North I., Waikato, Whatawhata

Abstract: Faecal contamination of rural streams is of increasing concern in New Zealand. This study assessed hill-country streams in the Whatawhata district that were impacted by pastoral farming, indigenous forest, or *Pinus radiata* forest; by measuring *Escherichia coli* bacteria at 14 sampling sites fortnightly for 2 years. *E. coli* concentrations were highest in streams flowing through grazed pasture. In both years there was a noticeable seasonal pattern in all streams irrespective of land use, with highest bacterial

concentrations in summer and autumn and lowest in winter and early spring. There was no obvious correlation between *E. coli* concentration and rainfall or stream flow. In those streams impacted by a change in land use from pastoral to pines during the study, *E. coli* concentration fell rapidly and remained at levels lower than those in streams impacted by either indigenous or 7-year pine forests. As *E. coli* was detected in all but two samples, the water in these streams is not suitable for human consumption. The pastoral streams consistently failed to meet stock drinking-water guidelines (median concentration not greater than 100 *E. coli* 100 ml super(-1)) and the forest streams failed to do so in summer. Twenty-eight percent of pastoral samples, 25% of indigenous forest samples, 14% of 7-year pine forest samples, and 5% in New Pines stream samples (after planting) had *E. coli* concentrations associated with a high level of risk for contact recreation (>500 *E. coli* 100 ml super(-1)) and the high concentrations usually occurred in summer.

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70. The impact of sheep trampling and stocking rate on the physical properties of a red duplex soil with two initially different structures.

Proffitt, A. P. B.; Jarvis, R. J.; and Bendotti, S.
Australian Journal of Agricultural Research 46(4): 733-747. (1995)

NAL Call #: 23 Au783; ISSN: 0004-9409

Descriptors: livestock industry/ grazing/ hydraulic conductivity/ seasonality

Abstract: The effect of sheep trampling and stocking rate on the physical properties of a red duplex soil with two initially different structures was examined over an 8 week period when the soil was wet following winter rains. The experimental site was located at Merredin in Western Australia where the average annual rainfall is 307 mm. A previous long-term tillage and gypsum trial at the experimental site had resulted in the development of contrasting topsoil structures. Three grazing treatments were imposed at the trial site: grazing at the normal high stocking rate (8 DSE ha⁻¹), grazing at half the normal stocking rate (4 DSE ha⁻¹), and no grazing (where pasture was mown to simulate grazing without trampling). Topsoil structure was assessed by measuring water-stable aggregation (gt 2 mm diameter aggregates), the relative contribution of dispersion and staking to structural instability (measured as soil strength on lt 2 mm fine earth soil fractions), steady-state infiltration rates (at 10 mm tension), and in situ soil strength characteristics (measured as penetration resistance). At the end of the grazing period, all structure attributes measured showed that topsoil structure had been damaged as a result of sheep trampling. The magnitude of such structure damage was affected by the initial physical condition of the soil and stocking rate. When compared with ungrazed pasture, there was a greater decline in structural condition as a consequence of grazing on less well-structured soil than on better-structured soil. Halving the normal stocking rate reduced the degree of structure damage on both soils. Within-season variability in soil hydraulic properties was large. The temporal changes in infiltration rates were attributed to changes in drainage pore volume brought about by the growth and decay of pasture roots, the formation and disruption of a surface crust, and the processes of soil compaction and remoulding resulting from animal trampling (no direct measurements

were made). The variability in hydraulic behaviour found in this study emphasizes the need to maintain consistent sampling dates and soil water contents at sampling in long-term studies on soil structure changes.

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71. Impact of tree clearing on soil pH and nutrient availability in grazing systems of central Queensland, Australia.

Sangha, K. K.; Jalota, R. K.; and Midmore, D. J.
Australian Journal of Soil Research 43(1): 51-60. (2005)
NAL Call #: 56.8 Au7; ISSN: 0004-9573

Descriptors: ammonium/ calcium/ copper/ deforestation/ electrical conductivity/ exchangeable calcium/ exchangeable magnesium/ exchangeable potassium/ exchangeable sodium/ grazing systems/ iron/ land clearance/ land productivity/ magnesium/ manganese/ nitrate/ nitrogen/ nutrient availability/ pastures/ phosphorus/ plant communities/ potassium/ sodium/ soil degradation/ soil depth/ soil fertility/ soil pH/ soil properties/ zinc

Abstract: In Queensland, Australia, land is cleared at high rates to develop pastures for enhanced production and the associated monetary gains. However, pasture production declines over time in cleared pastures until a new equilibrium is reached. The present study focused on elucidating the reasons for decline in pasture production and finding the key soil properties that are affected due to clearing. Paired sites for cleared and uncleared pastures were selected to represent 3 dominant tree communities of the semiarid tropics in central Queensland, i.e. *Eucalyptus populnea*, *E. melanophloia*, and *Acacia harpophylla*. The cleared pastures were chosen to represent 3 different durations of time since clearing (5, 11-13, and 33 years) to evaluate the temporal impact of clearing on soil properties. Various soil parameters were studied: macronutrients - available N (NH₄⁺ and NO₃⁻), total N, and available P; micronutrients - Cu, Fe, Zn, and Mn; exchangeable cations - Ca, Mg, Na, and K (also macronutrients); pHw; and electrical conductivity. Of these, pHw showed a significant response to time of clearing for all 3 tree communities. Soil pHw increased significantly at cleared sites relative to uncleared (native woodland) pastures, and the increase was highly correlated with concentrations of exchangeable Ca, Mg, and Na. The change in soil pHw and exchangeable cations was more evident at >0.30 m soil depth. The increase in soil pHw in cleared pastures decreased the availability of soil nutrients for plant growth and, hence, pasture productivity. The interactions of different soil properties down the profile as a result of changes caused by clearing are important when interpreting the effects of clearing on soil properties.

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72. Impacts of intensive rotational grazing on stream ecology and water quality.

Undersander, D. J. and Paine, L.
Sustainable Agriculture Research and Education (Sare) Research Projects North Central Region: 1 portfolio. (1998)
NAL Call #: S441.S8553

Descriptors: rotational grazing/ streams/ water quality/ environmental impact/ dairy farming/ livestock production/ Wisconsin

This citation is from AGRICOLA.

73. The impacts of nitrogen fertilisation and increased stocking rate on pasture yield, soil physical condition and nutrient losses in drainage from a cattle-grazed pasture.

Monaghan, R. M.; Paton, R. J.; Smith, L. C.; Drewry, J. J.; and Littlejohn, R. P.

New Zealand Journal of Agricultural Research 48(2): 227-240. (2005)

NAL Call #: 23 N4892; ISSN: 0028-8233

Descriptors: fertilization: applied and field techniques/ land management: applied and field techniques/ pasture yield/ soil physical condition

Abstract: The effects of increasing nitrogen (N) fertiliser inputs, and associated cattle stocking rates, on pasture yield and composition, soil physical quality and nutrient losses in drainage were measured in an experiment on permanent white clover/ryegrass pastures in eastern Southland, New Zealand. Treatments were established on hydrologically-isolated replicate plots (900 m²) where pastures received annual fertiliser N inputs of 0, 100, 200 or 400 kg ha⁻¹ and were grazed throughout spring, summer, and autumn of each year by non-lactating dairy cattle. Our aim was to determine if N fertilisation of cattle pastures led to the deterioration of pasture or soil quality, or to the excessive loss of nutrients in drainage over the 3-4 years after such land management started. Pasture and soil monitoring showed that N fertilisation and increased stocking rate resulted in large, but variable, increases in pasture yield, with little discernible effect on soil physical condition, as evidenced by twice-yearly measurements of soil bulk density, percentage of soil pores >300 µm, soil macroporosity (volumetric percentage of pores >30 µm), hydraulic conductivity, and air permeability. A cyclical pattern of spring soil compaction followed by recovery over summer, autumn, and winter was evident in the 0-5 cm soil layer within all treatments. Mean annual pasture responses to applied fertiliser N were 14.8, 12.9, and 9.1 kg DM kg⁻¹ N applied in the 100, 200, and 400 N treatments, respectively, with greater responses observed in spring than in autumn in 3 out of 4 years. N fertilisation significantly increased losses of nitrate-N and Ca in drainage but had no significant effect on K, Mg, Na, sulphate-S, Cl, and P drainage losses. Within the context of the potential for enriching groundwater supplies of domestic drinking water, these losses suggest that annual fertiliser N inputs should not exceed approx. 17C kg N ha⁻¹ yr⁻¹ at this site. Considered from the perspective of potential surface water enrichment with P and N promoting nuisance weed and algal growth, losses of N and P in drainage water exceeded currently accepted guidelines, especially for N. The responses measured in this study represent a system that has recently undergone an improvement in soil fertility along with a change from sheep to cattle grazing. We thus caution that our findings pertain to short-term changes in soil and plant responses and may not accurately reflect those in a system that has been in long-term (>20 years) equilibrium.

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74. Impacts of rotational grazing and riparian buffers on physicochemical and biological characteristics of southeastern Minnesota, USA, streams.

Sovell, Laurie A.; Vondracek, Bruce; Frost, Julia A.; and Mumford, Karen G.

Environmental Management 26(6): 629-641. (2000)

NAL Call #: HC79.E5E5; ISSN: 0364-152X

Descriptors: principal component analysis: pca, mathematical method/ canopy cover/ grass buffers/ pastures: continuously grazed, rotationally grazed/ percent fines: streambed/ physical habitat: stream quality parameter/ riparian buffer management/ riparian management/ stream quality/ stream restoration/ turbidity/ water chemistry: stream quality parameter/ watershed/ wood buffer

Abstract: We assessed the relationship between riparian management and stream quality along five southeastern Minnesota streams in 1995 and 1996. Specifically, we examined the effect of rotationally and continuously grazed pastures and different types of riparian buffer strips on water chemistry, physical habitat, benthic macroinvertebrates, and fish as indicators of stream quality. We collected data at 17 sites under different combinations of grazing and riparian management, using a longitudinal design on three streams and a paired watershed design on two others. Continuous and rotational grazing were compared along one longitudinal study stream and at the paired watershed. Riparian buffer management, fenced trees (wood buffer), fenced grass, and unfenced rotationally grazed areas were the focus along the two remaining longitudinal streams. Principal components analysis (PCA) of water chemistry, physical habitat, and biotic data indicated a local management effect. The ordinations separated continuous grazing from sites with rotational grazing and sites with wood buffers from those with grass buffers or rotationally grazed areas. Fecal coliform and turbidity were consistently higher at continuously grazed than rotationally grazed sites. Percent fines in the streambed were significantly higher at sites with wood buffers than grass and rotationally grazed areas, and canopy cover was similar at sites with wood and grass buffers. Benthic macroinvertebrate metrics were significant but were not consistent across grazing and riparian buffer management types. Fish density and abundance were related to riparian buffer type, rather than grazing practices. Our study has potentially important implications for stream restoration programs in the midwestern United States. Our comparisons suggest further consideration and study of a combination of grass and wood riparian buffer strips as midwestern stream management options, rather than universally installing wood buffers in every instance.

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75. Implications of nitrogen fertilizer applications and extended grazing for the N economy of grassland.

Laidlaw, A. S.; Watson, C. J.; and Mayne, C. S.

Grass and Forage Science 55(1): 37-46. (Mar. 2000)

NAL Call #: 60.19 B773; ISSN: 0142-5242

Descriptors: sward/ grasslands/ nitrogen balance/ grazing/ range management/ urea/ soil fertility/ nutrient availability/ nitrogen/ dry matter accumulation/ application timing/ Northern Ireland

This citation is from AGRICOLA.

76. Influence of cattle trampling on preferential flow paths in alkaline soils.

Dreccer, M. F. and Lavado, R. S.

Soil Use and Management 9(4): 143-148. (1993)

NAL Call #: S590.S68; ISSN: 0266-0032

Descriptors: pampas soils/ Mollisols/ Alfisols/ alkaline soils/ cattle/ water flow/ soil water/ macropore flow/ soil pore

system/ soil texture/ soil organic matter/ soil pH/ textural soil types/ grazing/ flooded conditions/ Natraquolls/ Natraqualfs/ porosity/ Argentina

Abstract: Preferential flow paths (PFP) are important in water and solute movement through soils, especially in regions where vertical water movements predominate, such as the flooding Pampa (Argentina). The impact of grazing on PFP and its interactions with other properties were studied in three soils with natric horizons in the flooding Pampa using an iodide colouring technique. In the soil with a mollic horizon (Typic Natraquoll), % PFP was decreased by trampling but was later restored by shrink-swell. In the Typic Natraqualf, the most alkaline of the studied soils, % PFP was very small under both grazed and ungrazed conditions. In a coarser textured soil (Mollic Natraqualf) trampling did not affect % PFP. The % PFP of the Ah horizons increased with increasing organic carbon and sand contents and decreased as clay content, pH and sodium adsorption ratio (SAR) increased. The Bt horizons had small % PFPs and were not affected by cattle trampling.

This citation is from AGRICOLA.

77. Influence of cattle trampling on soil porosity under alternate dry and ponded conditions.

Taboada, M. A. and Lavado, R. S.

Soil Use and Management 9(4): 139-143. (1993)

NAL Call #: S590.S68; ISSN: 0266-0032

Descriptors: Mollisols/ pampas soils/ A horizons/ cattle/ soil pore system/ soil water content/ soil mechanics/ soil compaction/ dry environmental conditions/ seasonal variation/ shrinkage/ soil aggregates/ grazing/ flooded conditions/ Natraquolls/ porosity/ Argentina

Abstract: Abstract: The impact of cattle trampling on the porosity of a representative soil (Typic Natraquoll) of the flooding Pampa of Argentina was studied from 1984 to 1987. Water content, total porosity (TP), macroporosity (> 30 micrometer) and mean weight diameter of water-stable aggregates (MWD) were determined in undisturbed topsoil samples taken from adjacent continuously grazed (1.0 animal unit/ha/yr) and ungrazed (since 1976) areas. It was expected that trampling would decrease macroporosity when the soil was ponded, and that the damaged macropores would regenerate during the subsequent soil drying. This was only partly verified. The soil varied in TP from 58 to 64% in the ungrazed area, and from 53 to 78% in the grazed area. This variation resulted mainly from shrink-swell processes. Trampling decreased soil macroporosity (mainly > 60 micrometer) from 8 to 5% and decreased MWD from 5.35 to 4.58 mm under dry soil conditions. The damaged soil pores regenerated and aggregate stability recovered during the subsequent period of surface water ponding, when soil swelling increased macropores in the grazed area but not in the ungrazed area. There was no evidence of poaching damage in this soil.

This citation is from AGRICOLA.

78. The influence of cutting and grazing on phosphorus and nitrogen in irrigation runoff from perennial pasture.

Mundy, G. N.; Nexhip, K. J.; Austin, N. R.; and Collins, M. D.

Australian Journal of Soil Research 41(4): 675-685. (2003)

NAL Call #: 56.8 Au7; ISSN: 0004-9573

Descriptors: flood irrigation: applied and field techniques/

regression model: mathematical and computer techniques/ animal excreta/ cutting impacts/ grazing impacts/ perennial pasture: flood irrigated/ runoff: flow weighted nitrogen concentration, flow weighted phosphorus concentration, total kjeldahl nitrogen concentration/ severely defoliated pasture/ stocking intensities/ successive flood irrigation events

Abstract: Runoff from flood-irrigated perennial pastures generally contains higher phosphorus (P) and nitrogen (N) concentrations than the irrigation water applied to the pastures. We examined the sources of P and N that could contribute to these elevated nutrient concentrations in runoff. The first experiment compared P and N losses in runoff from pasture cut to different residual pasture masses. Flow-weighted P and N concentrations and loads were about 100% higher from pasture cut to 47 mm above ground than from pasture standing at 155 mm. These results indicated that severely defoliated pasture may be a significant source of nutrients when flood irrigated. In the second experiment, pastures were defoliated at a single grazing with different stocking intensities and the flow-weighted P and N concentrations in runoff were determined during 4 successive flood irrigation events. Nitrogen and P concentrations in runoff after the first irrigation following defoliation were higher at the highest stocking intensity. However, the effect of the grazing on nutrient concentrations in runoff declined in subsequent irrigation events. A regression model fitted to the P data indicated that there was a significant linear increase in P concentrations with stocking density and a significant non-linear decline in concentrations with successive irrigations. A similar relationship for TKN concentrations in runoff at each stocking density over the 4 irrigation events was not found. An inconsistency of the TKN concentrations of the supply water between irrigation events possibly helped to mask a similar relationship between N concentrations in runoff and stocking density over the 4 irrigation events. We postulate that both animal excreta and the pasture itself can contribute to elevated nutrient concentrations in flood-irrigation runoff.

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79. Influence of off-stream supplements on streambanks of riparian pastures.

McInnis, M. L. and McIver, J.

Journal of Range Management 54(6): 648-652. (2001)

NAL Call #: 60.18 J82; ISSN: 0022-409X

http://jrm.library.arizona.edu/data/2001/546/648-652_mcinnis.pdf

Descriptors: grazing intensity/ beef cattle/ water erosion/ riverbank protection/ animal behavior/ dietary mineral supplements/ Oregon

Abstract: Accelerated erosion of streambanks in grazed riparian pastures is of concern to land managers. We tested the hypothesis that providing cattle free-choice off-stream water and trace mineralized salt would lessen negative impacts of grazing on cover and stability of streambanks compared to pastures lacking these amenities, and may therefore reduce the potential of accelerated erosion. The study was conducted on Milk Creek at the Hall Ranch Unit of the Eastern Oregon Agricultural Research Center near Union, Ore. Three replications each of 3 grazing treatments were examined: (1) non-grazed control; (2) grazed with supplemental water and trace mineralized salt provided ("supplemented"); and (3) grazed with no supplemental

water or salt ("nonsupplemented"). Each grazed pasture (approximately 12 ha) was stocked with cow-calf pairs for a mean stocking rate of 0.8 ha per AUM to achieve moderate grazing intensity of approximately 50% utilization of key forages. Pastures were grazed for 42 consecutive days during each of 2 years (1996-1997) beginning mid-July. Estimates of streambank cover ("covered" or "uncovered") and stability ("stable" or "unstable") were taken before (June) and after (September) grazing by examining 0.5 X 0.3 m plots placed on the greenline. Additionally, frequency of cattle hoof prints (number of plots with hoof prints/total number of plots) was measured as an indication of cattle presence in the greenline. Treatment effects were compared using one-way ANOVA. Streambank effects were consistent with observations of cattle distribution, with 26% of the streambank in supplemented pastures showing cattle presence (hoof prints), versus 31% for non-supplemented pastures. Off-stream water and salt attracted cattle into the uplands enough to significantly (p less than or equal to 0.05) reduce development of uncovered and unstable streambanks from 9% in non-supplemented pastures to 3% in supplemented pastures. An "erosion index" indicated no significant ($p < 0.05$) difference in potential accelerated streambank erosion between supplemented and non-supplemented pastures. This citation is from AGRICOLA.

80. Influence of pasture management on soil biological quality.

Banerjee, M. R.; Burton, D. L.; McCaughey, W. P.; and Grant, C. A.

Journal of Range Management 53(1): 127-133. (2000)
 NAL Call #: 60.18 J82; ISSN: 0022-409X
http://jrm.library.arizona.edu/data/2000/531/127-132_banerjee.pdf

Descriptors: soil water/ stocking rate/ rotational grazing/ nitrogen content/ carbon/ microorganisms/ biomass/ arylsulfatase/ enzyme activity/ alkaline phosphatase/ acid phosphatase/ Manitoba

Abstract: The long-term sustainability of pasture management systems, whether related to structural stability or nutrient dynamics, is dependent upon maintaining soil biological properties. This study investigates the extent to which the microbiological and biochemical properties of soil can change with season and pasture management system, including their likely value as indicators of soil quality. The experiment was conducted on a 30-ha pasture near Brandon, Manitoba. Seasonal fluctuations were observed in the soil microbial and biochemical properties. In general, these fluctuations were mainly independent of the small variations in soil organic matter content but were more closely related to soil water content. The data also suggests an impact of stocking rate and grazing system on soil microbial biomass C and on N mineralization potential. However, because duration of the investigation, limited number of replications and the high soil variability encountered, it is not yet possible to recommend any particular grazing system and/or stocking rate favorable for the maintenance of soil biological quality. The trends suggest that light, continuous grazing systems had the largest microbial biomass and nutrient mineralizing activity. This citation is from AGRICOLA.

81. Inorganic nitrogen in drainage water from grazed grassland in Northern Ireland.

Watson, C. J.; Jordan, C.; Lennox, S. D.; Smith, R. V.; and Steen, R. W. J.

Journal of Environmental Quality 29(1): 225-232. (2000)
 NAL Call #: QH540.J6; ISSN: 0047-2425

Descriptors: drainage water/ environmental quality/ grazed grassland/ river catchment/ surface water quality

Abstract: The loss of inorganic N in drainage water from grazed perennial ryegrass (*Lolium perenne* L. cv. Talbot) swards in Northern Ireland was studied for 9 yr. Plots (each 0.2-ha area) were hydrologically isolated and artificially drained to V-notch weirs with flow-proportional monitoring of drainage water. Nitrogen, as calcium ammonium nitrate, was applied at 100, 200, 300, 400, or 500 kg N ha⁻¹ yr⁻¹. The efficiency of flow interception by drains decreased on average by 39% during the 9 yr. Annual loss of NO₃⁻ in drain flow for the plot receiving 300 kg N ha⁻¹ yr⁻¹ ranged from 16 to 52 kg N ha⁻¹ and was highest after a dry summer. In individual years, NO₃⁻ in drainage water was linearly related to fertilizer N input with 5 to 23% of the added N input being lost. The shape of the NO₃⁻ dose-response curve did not change with time. Annual losses of NH₄⁺ and NO₂⁻ in drainage water were not related to fertilizer rate, and ranged from 0.2 to 4 kg N ha⁻¹ and 8 to 540 g N ha⁻¹, respectively. Annual flow-weighted mean NO₃⁻, NH₄⁺, and NO₂⁻ concentrations usually did not exceed the European Community maximum admissible limits for drinking water below a fertilizer N application rate of 300 kg N ha⁻¹ yr⁻¹. However, the European Community guideline NH₄⁺ and NO₂⁻ concentrations in salmonid and cyprinid waters were exceeded at application rates ≥ 100 kg N ha⁻¹ yr⁻¹.

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82. Land use effects on soil carbon fractions in the southeastern United States: Management-intensive versus extensive grazing.

Conant, Richard T.; Six, Johan; and Paustian, Keith

Biology and Fertility of Soils 38(6): 386-392. (2003)

NAL Call #: QH84.8.B46; ISSN: 0178-2762

Descriptors: land use effects/ management intensive

versus extensive grazing/ pasture conditions

Abstract: Changes in grassland management intended to increase productivity can lead to sequestration of substantial amounts of atmospheric C in soils. Management-intensive grazing (MiG) can increase forage production in mesic pastures, but potential impacts on soil C have not been evaluated. We sampled four pastures (to 50 cm depth) in Virginia, USA, under MiG and neighboring pastures that were extensively grazed or hayed to evaluate impacts of grazing management on total soil organic C and N pools, and soil C fractions. Total organic soil C averaged 8.4 Mg C ha⁻¹ (22% greater under MiG; differences were significant at three of the four sites examined while total soil N was greater for two sites. Surface (0-10 cm) particulate organic matter (POM) C increased at two sites; POM C for the entire depth increment (0-50 cm) did not differ significantly between grazing treatments at any of the sites. Mineral-associated C was related to silt plus clay content and tended to be greater under MiG. Neither soil C:N ratios, POM C, or POM C:total C ratios were accurate indicators of differences in total soil C between grazing treatments, though differences in total soil C between treatments attributable to changes in POM C (43%) were larger than

expected based on POM C as a percentage of total C (24.5%). Soil C sequestration rates, estimated by calculating total organic soil C differences between treatments (assuming they arose from changing grazing management and can be achieved elsewhere) and dividing by duration of treatment, averaged 0.41 Mg C ha⁻¹ year⁻¹ across the four sites.

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83. Land-use effects on water quality in an intensively managed catchment in the Australian humid tropics.

Bramley, R. G. V. and Roth, C. H.

Marine and Freshwater Research 53(5): 931-940. (2002)
NAL Call #: GC1.A85; ISSN: 1323-1650

Descriptors: agricultural production/ agricultural run off/ catchment management/ ecotoxicology/ environmental degradation/ forestry/ freshwater ecology/ grazing impact/ humid tropical environments/ land use effects/ riverine ecology/ sediment loads/ water quality

Abstract: The minimization of environmental degradation that might arise as a result of agricultural production requires a detailed knowledge of the off-site effects of rural land use. This paper reports the results of an assessment of the effect of land use on water quality in the lower part of the catchment of the Herbert River, an intensively managed part of the humid tropics in north Queensland, where the major land uses are sugarcane production, cattle grazing and forestry. Compared with grazing and forestry, sugarcane production was found to have a significant impact on riverine water quality as evidenced by higher concentrations of nitrogen (N), phosphorus (P) and total suspended solids (TSS) in stream-waters draining land under sugarcane, a finding that was unaffected by the inclusion of sampling sites dominated by upper-catchment grazing. However, land use had no significant effect on the partitioning of N and P between mineral, organic and particulate phases in stream-waters, although the proportion in particulate form tended to be least for sugarcane-dominated sites. Irrespective of land use, the concentrations of both total N and P were dominated by soluble fractions, particularly in organic combination. These results suggest that, irrespective of the ecological impact of these nutrient and sediment loadings on freshwaters and the near-shore zone, there is considerable room for improvement in land management in the Australian humid tropics in terms of minimizing off-site export of both nutrients and sediment.

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84. Leaching of nitrate and other nutrients from a grazed pasture.

Steele, K. W.; Judd, M. J.; and Shannon, P. W.

New Zealand Journal of Agricultural Research 27(1): 5-12. (1984)

NAL Call #: 23 N4892; ISSN: 0028-8233

Descriptors: *Lolium perenne*/ *Trifolium repens*/ *Paspalum dilatatum*/ cattle/ percolation/ calcium

Abstract: The amounts of NO₃⁻ and other nutrients leached from an intensively grazed pasture [*Lolium perenne*, *Trifolium repens*, *Paspalum dilatatum*] over 1 yr were determined. Concentrations of NH₄⁺, NO₃⁻, Ca²⁺, Mg²⁺, Na⁺, K⁺, SO₄²⁻, PO₄³⁻ and Cl⁻ were measured in samples of water percolating through soil (Ruatangata friable clay) under cattle grazed pastures receiving 0 or 172 kg N/ha per yr as urea. Elemental concentrations varied

greatly with both site and time of collection. The equivalent concentrations of NO₃⁻ and Ca²⁺ were highly correlated ($r^2 = 0.96$) and could be used for estimating the equivalent concentrations of the other ions. For each unit increase in the concentration of NO₃⁻, the equivalent concentration of cations increased in the order: Ca > Mg > Na > K. The amount of element leached was calculated as the product of measured concentration and estimated drainage volume. Leaching losses over 1 yr (kg/ha nil-N treatment; kg/ha + N treatment) were thus estimated as N (88; 193); Ca (154; 216); Mg (32; 44); Na (71; 86); and K (14; 21), respectively. Rainfall and estimated drainage were 1840 and 985 mm, respectively.

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85. Long-term effects of various conservation management treatments on selected soil properties of chalk grassland.

Rizand, A.; Marrs, R. H.; Gough, M. W.; and Wells, T. C. E.

Biological Conservation 49(2): 105-112. (1989)

NAL Call #: S900.B5; ISSN: 0006-3207

Descriptors: grazing/ succession/ nitrogen/ mineralization/ phosphorus/ sorption

Abstract: Soils were collected from a long-term (22-year) conservation management experiment on chalk grassland. This experiment was designed initially to compare different annual cutting frequencies (with and without the return of clippings) with untreated plots, where successional development was allowed, but in this study an adjacent grazed area was also included. Concentrations of inorganic N, rates of nitrogen mineralization and nitrification were estimated, and phosphate adsorption curves calculated. After 22 years' treatment, nitrogen mineralization was higher in the untreated plots than in some treated plots, but the most consistent result was a reduction in P sorption, and hence a greater availability of added P, in the plots where the clippings had been returned, implying a potential improvement in phosphorus availability. If this trend were to be continued over a much longer time period, there might be implications for species change.

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86. Long-term management impacts on soil carbon and nitrogen dynamics of grazed bermudagrass pastures.

Wright, A. L.; Hons, F. M.; and Rouquette, F. M.

Soil Biology and Biochemistry 36(11):

1809-1816. (Nov. 2004)

NAL Call #: S592.7.A1S6; ISSN: 0038-0717

Descriptors: soil organic matter/ carbon/ nitrogen/ soil nutrient dynamics/ cattle/ grazing intensity/ *Cynodon dactylon*/ pasture management/ carbon sequestration/ mineralization/ sandy loam soils/ mineral fertilizers/ sowing/ *Lolium multiflorum*/ *Trifolium*/ Texas

Abstract: Managed pastures have potential for C and N sequestration in addition to providing forage for livestock. Our objectives were to investigate changes in soil organic C (SOC) and soil organic N (SON) concentrations and mineralizable C and N in cattle (*Bos indicus*) grazed bermudagrass [*Cynodon dactylon* (L.) Pers.] pastures up to 32 y after establishment. Management included low- and high-grazing intensity, fertilization, and winter overseeding with annual ryegrass (*Lolium multiflorum* Lam.) and clover (*Trifolium* sp.). Soil (0-15 cm) was sampled 7, 15, 26, and 32 y after establishment of Coastal and common bermudagrass pastures. No significant differences in SOC

or SON concentrations were observed between Coastal and common bermudagrass pastures. Grazing strategies played important roles in C and N sequestration, as high-grazing intensity resulted in a lower increase in SOC and SON concentrations over time compared to low-grazing intensity. Increases in SOC were observed up to 26 y, while increases in SON were observed up to 32 y after establishment of bermudagrass pastures. Soil organic C increased 67 and 39% from 7 to 26 y at low-grazing intensity for bermudagrass+ryegrass and bermudagrass+clover pastures, respectively. SOC and SON concentrations did not increase beyond 15 y after bermudagrass establishment at high-grazing intensity. An exception was the Coastal bermudagrass+ryegrass pastures, which exhibited higher SON at 32 y than at 7 y at both grazing intensities. By 32 y, SON increased 83 and 45% in Coastal bermudagrass+ryegrass pastures at low- and high-grazing intensity, respectively, compared to 7 y. The introduction of clover to pastures decreased SOC and SON relative to ryegrass at high- but not at low-grazing intensity. Potentially mineralizable C increased from 7 to 15 y, while mineralizable N increased from 7 to 32 y. Potentially mineralizable N was also greater for bermudagrass+clover than bermudagrass+ryegrass pastures. Long-term increases in SOC and SON concentrations suggest that managed and grazed pastures have strong potential for C and N sequestration. This citation is from AGRICOLA.

87. Losses of nitrogen phosphorus and sediment in runoff from hill country under different fertilizer and grazing management regimes.

Lambert, M. G.; Devantier, B. P.; Nes, P.; and Penny, P. E. *New Zealand Journal of Agricultural Research* 28(3): 371-380. (1985)

NAL Call #: 23 N4892; ISSN: 0028-8233

Descriptors: sheep/ cattle/ erosion/ stocking rate/ eutrophication/ New Zealand

Abstract: Eight 0.1-1.5 ha catchments within a grazing trial in steep hill country near Woodville, New Zealand, were monitored for 19-53 months during 1975-79. Experimental treatments with 3 grazing managements [rotational grazing with sheep (RGS) or cattle (RGC), or set stocking with sheep (SSS)] and 2 fertiliser practices [low (LF) = 11 kg P ha⁻¹ year⁻¹, high (HF) = 64 kg P ha⁻¹ year⁻¹ + lime]. Stocking rates were 27% higher on HF than LF areas. Runoff, and nitrogen (N), phosphorus (P), and sediment concentrations in runoff, were measured. Average annual rainfall and runoff values were 1247 and 555 mm, respectively. Sediment losses were greater under RGC (2740 kg ha⁻¹ year⁻¹) than sheep grazing (average of RGS and SSS = 1220 kg ha⁻¹ year⁻¹). Total N and P losses in runoff from RGC catchments (12.1 kg N and 1.5 kg P ha⁻¹ year⁻¹) were higher than from sheep-grazed catchments (8.7 kg N and 0.7 kg P ha⁻¹ year⁻¹). No significant differences were found between RGS and SSS catchments. Although concentrations of N and P in runoff water were higher for HF than LF catchments, total N and P losses were similar because HF runoff volume was about 25% lower. The proportion of total N and P in dissolved inorganic form in runoff tended to be higher for HF than LF catchments. This study showed that increases in fertiliser application and stocking rate on hill country might not

increase total N and P losses, but can increase nutrient loading of runoff waters. This may result in accelerated eutrophication.

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88. Management options to limit nitrate leaching from grassland.

Cuttle, S. P. and Scholefield, D.

Journal of Contaminant Hydrology 20(3-4): 229-312. (1995)
NAL Call #: TD426.J68; ISSN: 0169-7722.

Notes: Conference: Integrated Nitrogen Management in Relation to Leaching and Groundwater Quality, 15. World Congress of Soil Science, Acapulco (Mexico), 10-16 Jul 1994

Descriptors: nitrates/ leaching/ grasslands/ grazing/ manure/ management planning/ economic aspects/ cycling nutrients

Abstract: Nitrate leaching can be reduced by the adoption of less intensive grassland systems which, though requiring a greater land area to achieve the same agricultural output, result in less nitrate leaching per unit of production than do intensively managed grasslands. The economic penalties associated with reductions in output can be partly offset by greater reliance on symbiotic nitrogen fixation and the use of clover-based swards in place of synthetic N fertilisers. Alternatively, specific measures can be adopted to improve the efficiency of nitrogen use in intensively managed systems in order to maintain high outputs but with reduced losses. Controls should take account of other forms of loss and flows of nitrogen between grassland and other components of the whole-farm system and, in most instances, should result in an overall reduction in nitrogen inputs. Removing stock from the fields earlier in the grazing season will reduce the accumulation of high concentrations of potentially leachable nitrate in the soil of grazed pastures but will increase the quantity of manure produced by housed animals and the need to recycle this effectively. Supplementing grass diets with low-nitrogen forages such as maize silage will reduce the quantity of nitrogen excreted by livestock but may increase the potential for nitrate leaching elsewhere on the farm if changes to cropping patterns involve more frequent cultivation of grassland. Improved utilisation by the sward of nitrogen in animal excreta and manures and released by mineralisation of soil organic matter will permit equivalent reductions to be made in fertiliser inputs, provided that adequate information is available about the supply of nitrogen from these non-fertiliser sources.

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89. Management practices for minimising nitrate leaching after ploughing temporary leguminous pastures in Canterbury, New Zealand.

Francis, G. S.

Journal of Contaminant Hydrology 20(3-4): 313-327. (1995)
NAL Call #: TD426.J68; ISSN: 0169-7722

Descriptors: ammonium/ dicyandiamide/ grazing/ nitrification inhibitor/ rainfall distribution/ seasonality/ urine

Abstract: Winter leaching losses of nitrate following the ploughing of temporary leguminous pastures in late summer or early autumn are a major concern in mixed cropping rotations on the Canterbury Plains of New Zealand. Field experiments showed that pastures ploughed in early autumn (March) and left fallow accumulated 107-142 kg ha⁻¹ N of mineral-N in the soil profile by the start of

winter, with 72-106 kg ha⁻¹ N lost through leaching in the first winter. Delaying the ploughing of pasture until late autumn (May) reduced the accumulation of mineral-N to 42-120 kg ha⁻¹ N and the leaching loss to 8-52 kg ha⁻¹ N. In situations where early cultivation cannot be avoided, growing winter cover crops or using the nitrification inhibitor dicyandiamide (DCD) both have the potential to reduce leaching compared with fallow soil. DCD increased the amount of mineral-N present in the soil as ammonium and reduced leaching losses by 25-50% without affecting the yield of the following spring wheat crop. Cover crops only reduced leaching losses (by up to 60%) when they were sown early in the autumn and they had taken up considerable amounts of soil mineral-N before drainage occurred. When cover crops were grazed before incorporation in spring, there was an increased risk of leaching from urine patch areas. If residues were incorporated without grazing, however, the yield of the following spring wheat crop was depressed by 20-30% due to extensive net N immobilization during decomposition of the residues. In Canterbury conditions, the most reliable way to minimise N leaching losses is to delay the ploughing of pasture for as long as possible in autumn or winter. Where pastures are ploughed early, the relative effectiveness of using DCD or growing winter cover crops varies mainly in relation to rainfall distribution.
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90. Managing phosphorus levels in Arkansas pastures.

Sandage, L. and Kratz, D.
Proceedings of the Forage and Grassland Conference 7: 129-132. (1998)
NAL Call #: SB193.F59; ISSN: 0886-6899
Descriptors: rotational grazing/ water quality/ environmental impact
This citation is from AGRICOLA.

91. Methods for monitoring the effects of grazing management on bank erosion and channel morphology, Fever River, Pioneer Farm, Wisconsin, 2004.

Peppler, Marie C. and Fitzpatrick, Faith A. U.S. Geological Survey, 2005. Fact Sheet.
<http://pubs.usgs.gov/fs/2005/3134/>
Descriptors: grazing management/ bank erosion
Abstract: "In May 2002, seven rotational-deferred paddocks were established in a riparian pasture along a 0.8-mile reach, or section, of the Fever River at the University of Wisconsin (UW)-Platteville Pioneer Agricultural Stewardship Farm in southwestern Wisconsin (fig. 1). From 1996 to 2002, this pasture had been used for rotational grazing in five paddocks. In 2002, the fences were changed to create the seven present (2004) paddocks. Four cattle crossings were installed by the end of winter 2003. In 2001, the U.S. Geological Survey (USGS) began monitoring runoff, solids, nutrients, bacteria, and selected pesticides from various upland fields with a variety of best management practices. Some of the sampling locations for this study are noted in figure 1. In June 2004, the USGS, in cooperation with the UW-Platteville Pioneer Farm, began monitoring bank and channel changes along the river through this reach. Channel and bank monitoring is designed to continue indefinitely. It is hoped that the methods used during this study can be applied in other grazing locations."

92. Modelling environmental impacts of deposition of excreted nitrogen by grazing dairy cows.

McGechan, M. B. and Topp, C. F. E.
Agriculture, Ecosystems & Environment 103(1): 149-164. (2004)
NAL Call #: S601.A34; ISSN: 0167-8809
Descriptors: dual porosity contaminant transport model macro: mathematical and computer techniques/ grass growth model: mathematical and computer techniques/ soil nitrogen and carbon dynamics model soiln: mathematical and computer techniques/ environmental pollution/ grazing conditions/ grazing dairy cow excreted nitrogen deposition: environmental impacts/ localized stocking rate/ overall stocking rate/ pollution loads/ silage/ soil macropores/ spatially non uniform excretion
Abstract: The soil nitrogen (N) and carbon dynamics model SOILN (which has interactive links to a grass growth model), and the dual-porosity contaminant transport model MACRO, have been used to study environmental pollution arising from grazing dairy cows. The models had been calibrated and tested in previous studies related to livestock agriculture. Information about N contents and other characteristics of urine and faeces excreted by dairy cows was assembled from literature sources. Watercourse pollution by nitrate and ammonium was the main environmental impact considered. Denitrified nitrogen losses were also estimated as an indicator of nitrous oxide pollution of air. Higher levels of nitrate pollution in tile drains (which feed into watercourses) were shown to arise under grazing compared to fields receiving slurry and cut for silage. Much of this raised nitrogenous pollution arises late in the grazing season. High levels of nitrate pollution could be attributed to various factors, including the fact that cows tend to congregate in certain areas of a field at a localised stocking rate much higher than the overall stocking rate, and due to deposition of N at times when grass cannot utilise it as a plant nutrient. The fact that urine and faeces patches are concentrated over a small proportion of the field area did not give an increase in overall loss when this was considered along with field areas receiving no excretions. Rapid transport through soil macropores of ammonium from urine led to high pollution loads during grazing on wet soil. In contrast to leaching, simulated N losses by denitrification were at a low level, and appeared to show little variation with factors which had a large effect on leaching losses. Overall, the forms of pollution most damaging to the environment due to spatially non-uniform excretion by grazing animals, appeared to be leached ammonium from urine transported by macropore flow, and leached nitrate exacerbated both due to cows congregating and due to deposition at times of low plant N uptake.
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93. Modelling phosphorus leaching to watercourses from extended autumn grazing by cattle.

McGechan, M. B.
Grass and Forage Science 58(2): 151-159. (June 2003)
NAL Call #: 60.19 B773; ISSN: 0142-5242
Descriptors: agricultural management models/ hydrologic models/ soil transport processes/ simulation models/ macropore flow/ phosphorus/ soil pore system/ dairy cows/ grazing/ cattle manure/ water pollution/ losses from soil/ drainage/ pasture management/ seasonal variation/ soil water regimes/ autumn/ soil water/ United Kingdom

Abstract: A modelling approach was undertaken to investigate the effect of grazing animals on phosphorus pollution of water draining from grazed fields. Following a similar study in relation to slurry spreading in winter, the dual-porosity hydrological and contaminant transport model, MACRO, was calibrated to represent transport of phosphorus from faeces through the soil to field drains. Rapid flows, through water-filled macropores in wet soil, of phosphorus sorbed onto colloidal particles in the faeces of cattle appeared to be the dominant transport mechanism. The outputs of the model supported experimental evidence that levels of phosphorus pollution of water draining from grazed fields can rise substantially if grazing is extended into late autumn, particularly if grazing is extended until soil has wetted up to around the field capacity water content. The critical housing date, to avoid phosphorus losses rising to an unacceptable level, varied considerably between years. The outputs of the model suggest that phosphorus pollution does not occur during grazing under dry conditions where soil macropores do not contain water, so that losses would remain low if animals are housed before soil substantially wets up in the autumn. This citation is from AGRICOLA.

94. Nitrate leaching affected by management options with respect to urine-affected areas and groundwater levels for grazed grassland.

Hack Ten Broeke, M. J. D. and Van Der Putten, A. H. J. *Agriculture, Ecosystems & Environment* 66(3): 197-210. (1997)

NAL Call #: S601 .A34; ISSN: 0167-8809

Descriptors: simulation modeling: modeling method/ grazed grassland/ groundwater levels/ management options/ management strategy/ nitrate leaching/ urine affected areas/ soil science

Abstract: Simulations were performed to quantify the effects of management options on nitrate leaching to the groundwater in grazed pastures. At the experimental farm for sustainable dairy farming 'De Marke', experimental data on soil water and nitrates were gathered for two fields during the years 1991-1995. These data were used for model validation. The simulations showed that a detailed type of precision agriculture, which can identify urine-affected areas in the field and then subsequently omit fertilizing such areas, resulted in considerable reductions of simulated nitrate concentrations in the soil water, especially on an intensively grazed and relatively dry site with groundwater levels between 0.5 and 2.8 m. On the wetter site, the maximum calculated reduction in nitrate concentrations was 11%, but for the relatively dry site the maximum calculated reduction was as high as 41%. The second simulated option involved the raising of groundwater levels, which usually also resulted in a decrease in simulated nitrate concentrations. Under wet conditions, the groundwater level increase ultimately lead to increased nitrate leaching. The combined effect of non-fertilization of urine patches and the raising of groundwater levels usually resulted in higher simulated reductions of nitrate concentrations than the single options. When the effect of within-field variability was also considered, the raising of groundwater levels was most effective in reducing nitrate concentrations on the wet site, while on the relatively dry and intensively used site, the non-fertilization of urine-

affected areas had the dominant effect. The study shows how simulation modelling can assist in identifying promising management strategies.

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95. Nitrate leaching from grazed grassland and after straw incorporation in arable soils.

Jarvis, S. C.; Barraclough, D.; Unwin, R. J.; and Royle, S. M.

In: Management systems to reduce impact of nitrates/ Germon, J. C. and Dupain, S. New York: Elsevier Applied Science, 1989; pp. 110-125.

Notes: ISBN: 1851664025

NAL Call #: TD427.N5M3

Descriptors: grazing/ grasslands/ nitrates/ leaching/ arable soils/ straw/ groundwater contamination/ fertilizer application/ nitrogen fertilizers/ United Kingdom This citation is from AGRICOLA.

96. Nitrate leaching from intensively grazed pastures.

Stout, W. L.; Elwinger, G. F.; Fales, S. L.; Muller, L. D.; Schnabel, R. R.; and Priddy, W. E.

American Forage and Grassland Council Proceedings 5: 216-220. (1996)

NAL Call #: SB193.F59

Descriptors: pastures/ range management/ grazing/ nitrogen/ fertilizers/ urea/ leaching/ dairy farming/ seasonal variation/ cattle manure/ Pennsylvania

This citation is from AGRICOLA.

97. Nitrate leaching from intensively grazed swards.

Lord, E. I.

In: Proceedings: The Fertiliser Society.; Vol. 327. London: Fertiliser Society; 29 p.; 1992.

Notes: ISSN 0369-9277

NAL Call #: 57.9 F41

Descriptors: pastures/ nitrates/ leaching/ cattle/ grazing intensity/ cutting/ nitrogen/ losses from soil/ range management

This citation is from AGRICOLA.

98. Nitrate leaching from sheep-grazed upland pastures in Wales.

Cuttle, S. P.; Hallard, M.; Gill, E. K.; and Scurlock, R. V. *Journal of Agricultural Science* 127(pt.3): 365-375. (1996)

NAL Call #: 10 J822; ISSN: 0021-8596

Descriptors: pastures/ nitrates/ leaching/ quantitative analysis/ sheep/ grazing intensity/ nitrogen/ losses from soil/ range management/ nitrogen fertilizers/ symbiosis/ nitrogen fixation/ streams/ water pollution/ application rate/ highlands/ Wales

Abstract: Ceramic cup samplers were used to measure nitrate leaching from grass/clover pasture in Wales to which no N fertilizer had been applied and from a predominantly grass pasture receiving 100 kg fertilizer-N/ha annually. Annual leaching losses at individual sampling points, measured over a 3-year period between 1988 and 1991, ranged from the equivalent of < 0.1 to 226 kg N/ha. All data sets were positively skewed and in four out of six cases conformed to a log-normal distribution. The marked spatial heterogeneity was attributed to the uneven deposition of N in the excrete of grazing stock but variations in soil depth and hydrology may also have contributed. Particularly large losses occurred from those areas of the plots where sheep congregated. As a result of this heterogeneity, there were

large standard errors associated with estimates of mean losses from the pastures as a whole. Overall losses ranged from 13 to 24 kg N/ha per year from grass/clover plots and from 10 to 13 kg/ha from fertilized grass plots. There was no consistent relationship between relative losses from the two types of pasture. The quantity of nitrate leached appeared to be independent of stocking rate, although there was a direct correspondence between the loss from grass/clover plots and the proportion of clover in the sward. Estimates of nitrate concentrations in drainage never exceeded 5.6 mg N/l for either sward. This citation is from AGRICOLA.

99. Nitrate leaching from temperate perennial pastures grazed by dairy cows in south-eastern Australia.

Eckard, R. J.; White, R. E.; Edis, R.; Smith, A.; and Chapman, D. F.
Australian Journal of Agricultural Research 55(9): 911-920. (2004)
 NAL Call #: 23 Au783; ISSN: 0004-9409
 Descriptors: drainage/ nitrates/ fertilizers/ leaching/ ammonium/ pasture/ dairies/ livestock/ grasses/ Australia
 Abstract: Nitrate (NO₃-N) leaching losses were measured over 3 years from a temperate grass/clover pasture with and without 200 kg N fertilizer/ha, applied as ammonium nitrate or urea, using a system of moles and tile drains. Fertiliser was applied in 4 split dressings of 50 kg N/ha in each of the 4 seasons of each year. Drainage was collected continuously and NO₃-N concentrations in drainage water were measured in subsamples collected using a flow-proportioned sampler. Pastures were rotationally grazed with dairy cows at stocking rates equivalent to 1.9 or 2.8 cows/ha for the unfertilised and fertilised treatments, respectively. Soil water deficit (SWD) varied markedly between seasons and years, with drainage occurring in the cooler, wetter months (April-October) and not at all through the summer. There were no significant differences between treatments in SWD, drainage events, or drainage volumes. Peak NO₃-N concentrations were 19, 50, and 17 mg/L for the control, ammonium nitrate, and urea treatments, respectively. Mean annual flow-weighted NO₃-N concentrations over the 3 years were 1.7 and 2.2 times higher from the ammonium nitrate treatment than from the urea and control treatments, respectively. Annual NO₃-N leaching loads (kg N/ha) were 3.7-14.6 from the control treatment, 6.2-22.0 from the urea treatment, and 4.3-37.6 from the ammonium nitrate treatment, for the lowest and highest drainage years, respectively. The experiment confirmed that the application of N fertiliser prior to periods of substantial drainage can result in high losses of NO₃-N through leaching. More efficient and environmentally sound use of N fertiliser can be achieved by not combining high N fertiliser rates, high stocking intensity, and nitrate-containing fertilisers prior to periods when there is a risk of substantial drainage occurring.
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100. Nitrate loss through leaching and surface runoff from grassland effects of water supply soil type and management.

Garwood, E. A. and Ryden, J. C.
 In: Nitrogen fluxes in intensive grassland systems. (Held 1983 at Wageningen, Netherlands.) Van der Meer, H. G.; Ryden, J. C.; and Ennik, G. C. (eds.)

Dordrecht, Netherlands: Kluwer Academic Publishers; 1986.

Notes: EEC (European Economic Community) Workshop; ISSN 0167-840X
 NAL Call #: S596.7.D4 v.23; ISBN: 902473309X
 Descriptors: sward/ fertilizer/ denitrification/ utilization/ grazing/ cutting/ urine
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101. Nitrogen loss from a high fertility rotational pasture program.

Owens, L. B.; Van Keuren, R. W.; and Edwards, W. M.
Journal of Environmental Quality 12(3): 346-350. (1983)
 NAL Call #: QH540.J6; ISSN: 0047-2425
 Descriptors: water pollution/ winter grazing/ nonpoint source pollution/ agricultural practice/ grazing system/ nitrate transport/ Ohio/ USA
 Abstract: A beef cattle-pasturing system involving 4 rotationally grazed summer pastures (SG) and 4 pastures used rotationally for winter grazing/feeding (WGF) was studied on sloping upland watersheds in Ohio [USA] to determine effects of livestock management on N levels in water. Both summer and winter areas annually received 224 kg N/ha as NH₄NO₃ fertilizer. Surface runoff was collected automatically during runoff events, and subsurface flow was sampled from spring developments on a weekly basis. Although seasonal N concentration and transport in surface runoff tended to be greater in the area occupied by the cattle, N concentration and transport in runoff from the 2 areas were quite similar and did not significantly impair water quality, based on USA Public Health Standards. The NO₃-N concentration in the subsurface flow from the WGF area was higher than in the subsurface flow from the SG area. The NO₃-N concentration in the subsurface flow from both areas increased progressively throughout the study period, and reached levels as high as 18 mg/l. The subsurface flow provided the main pathway for N transport, with the surface transport being approximately 20 and 14% of the total N transport from the SG and WGF areas, respectively. The amount of sediment-N transported was very small because of low soil loss.
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102. Nonpoint-source pollutant load reductions associated with livestock exclusion.

Line, D. E.; Harman, W. A.; Jennings, G. D.; Thompson, E. J.; and Osmond, D. L.
Journal of Environmental Quality 29(6): 1882-1890. (2000)
 NAL Call #: QH540.J6; ISSN: 0047-2425
 Descriptors: grazing/ livestock exclusion/ nonpoint source pollutant load reduction/ riparian corridor/ sediment load/ streams/ tree planting
 Abstract: Cattle (*Bos taurus*) grazing on unimproved pastures can be a significant, yet often overlooked, source of pollutants to surface waters, especially when the cattle have unlimited access to streams in the pastures. Livestock exclusion from streams has been demonstrated to reduce sediment and possibly nutrient yield from streams draining pastures. The purpose of this study was to evaluate the effects of excluding dairy cows from, and planting trees in, a 335-m-long and 10- to 16-m-wide riparian corridor along a small North Carolina stream. Analysis of 81 wk of pre-exclusion and 137 wk of post-exclusion fencing data documented 33,78,76, and 82% reductions in weekly

nitrate+nitrite, total Kjeldahl nitrogen (TKN), total phosphorus (TP), and sediment loads, respectively, from the 14.9-ha pasture area adjacent to the fenced section of stream. Statistical analyses by t-tests and analysis of variance suggested that the reductions in mean weekly loads post-fencing were significant ($P < 0.05$) for all pollutants except nitrate+nitrite. Thus, the results indicated that livestock exclusion and subsequent riparian vegetation establishment was effective at reducing pollutant export from an intensively grazed pasture.
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103. Nutrient losses from management intensive grazing dairy farms.

Weil, R. R. and Gilker, R. E.
Proceedings American Forage and Grassland Council 13: 302-306. (2004)
NAL Call #: SB193.F59
Descriptors: dairy farming/ grazing/ pastures/ best management practices/ Maryland
This citation is from AGRICOLA.

104. Off-stream water sources for grazing cattle as a stream bank stabilization and water quality BMP.

Sheffield, Ronald Erle
Blacksburg, Va.: Virginia Polytechnic Institute and State University, 1996.
Notes: Thesis (M.S.); Bibliography: leaves 147-153.
NAL Call #: ViBibV LD5655.V855-1996.S544
This citation is from AGRICOLA.

105. Off-stream water sources for grazing cattle as a stream bank stabilization and water quality BMP.

Sheffield, R. E.; Mostaghimi, S.; Vaughan, D. H.; Collins, E. R.; and Allen, V. G.
Transactions of the ASAE 40(3): 595-604. (1997)
NAL Call #: 290.9 Am32T; ISSN: 0001-2351
Descriptors: stream erosion/ range management/ beef cattle/ drinking/ water supply/ water troughs/ erosion control/ water quality/ rotational grazing/ best management practices/ Virginia
Abstract: A multi-disciplinary study was conducted to evaluate effectiveness of providing cattle with an off-stream water source (i.e., water trough) in reducing stream bank erosion and fostering water quality improvements. This study was conducted on two commercial cow-calf operations in southwest Virginia which used rotational stocking. When given the choice, cattle were observed to drink from a water trough 92% of the time, compared to the time which they spent drinking from the stream. Stream bank erosion was reduced by 77% due to installation of the alternative water source. Concentrations of total suspended solids, total nitrogen, and total phosphorus reduced by 90, 54, and 81%, respectively when an alternative water source was provided. Similar reductions were observed in concentrations of fecal coliform and fecal streptococcus. Concentrations of dissolved nutrients such as nitrate and orthophosphorus, however, were adversely affected by installation of the BMP. The study results clearly indicate that off-stream water sources for grazing cattle are effective BMPs for reducing the loss of sediment and sediment-bound pollutants to adjacent streams without resorting to stream bank fencing.
This citation is from AGRICOLA.

106. Offstream water and salt as management strategies for improved cattle distribution and subsequent riparian health.

Dickard, M. L.; Momont, P. A.; DelCurto, T.; Rimbey, N. R.; Tanaka, J. A.; and McInnis, M.
Eastern Oregon Agricultural Research Center: Annual Report: 65-72. (1998)
NAL Call #: 100 Or3M no.991
Descriptors: grazing/ water quality/ animal husbandry/ cattle/ Oregon
This citation is from AGRICOLA.

107. Pasture management influences on soil properties in the northern Great Plains.

Wienhold, B. J.; Hendrickson, J. R.; and Karn, J. F.
Journal of Soil and Water Conservation 56(1): 27-31. (2001)
NAL Call #: 56.8 J822; ISSN: 0022-4561
Descriptors: grazing management/ microbe numbers/ mixed grass prairie/ N mineralization/ North Dakota/ organic C/ soil quality
Abstract: The effect of management practices associated with livestock grazing on soil properties are largely unknown. Several physical, chemical, and biological soil properties were compared for soil from a native vegetation enclosure, a moderately grazed native vegetation pasture stocked at 2.6 ha (6.4 ac) steer-1, a heavily grazed native vegetation pasture stocked at 0.9 ha steer-1 and a fertilized crested wheatgrass (*Agropyron cristatum* L. Gaertn.) pasture stocked at 0.9 ha steer-1 near Mandan, North Dakota. The three native vegetation pastures were established in 1916 and the crested wheatgrass pasture was seeded in 1932. Soil properties varied in sensitivity to the management practices. Measures of vegetation and animal production, combined with assessment of soil properties suggest that moderate grazing and fertilization of crested wheatgrass are viable management options that appear to be sustainable while providing goods and services needed by society. Range and pasture assessment should include soil assessment to more completely determine management effects on pastoral ecosystems.
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108. Patterns and simulation of soil water under different grazing management systems in central Alberta.

Mapfumo, E.; Chanasyk, D. S.; and Baron, V. S.
Canadian Journal of Soil Science 83(5): 601-614. (2003)
NAL Call #: 56.8 C162; ISSN: 0008-4271
Descriptors: VB2000 model: mathematical and computer techniques/ versatile soil moisture budget model: mathematical and computer techniques/ neutron moisture probe: field equipment/ soil water measurement: applied and field techniques/ daily volumetric soil water content/ evapotranspiration rates/ forage systems/ grazing management systems/ grazing systems/ grazing treatments: rotational grazed, ungrazed/ input data errors/ model errors/ overall modeling efficiency/ paddock/ propagation errors/ soil water: content, patterns
Abstract: A study was conducted at the Lacombe Research Centre to quantify and simulate the impacts of forage and grazing systems on soil water content. Four forages used in the study were alfalfa (*Medicago sativa* L.), a mixture of meadow bromegrass (*Bromus riparius* L.) and

alfalfa, an annual pasture and an old grass pasture that was composed of mainly quackgrass (*Elytrigia repens* L.), smooth bromegrass (*Bromus inermis* L.) and Kentucky bluegrass (*Poa pratensis* L.). Within each 1.2-ha paddock were two grazing treatments: rotational grazed and ungrazed. Soil water measurements to a 65-cm depth were conducted between May and October of 1999 and 2000 using a neutron moisture probe. Total soil water was affected by forage species more than grazing. Actual evapotranspiration rates were 3-4 mm d⁻¹ in both years. Simulation of daily volumetric soil water content (%) for each year was conducted using the Versatile Soil Moisture Budget (VB2000) model on grazed alfalfa, ungrazed alfalfa, grazed annual and ungrazed annual treatments. During calibration year of 1999, the overall modeling efficiency (EF) was 0.58 while, during the evaluation year it was 0.43. Further, simulations for alfalfa were better than those for annual treatments. These EF values are relatively low indicating substantial discrepancies between observed and simulated results, which could have been attributed to a combination of input data errors, model errors and propagation errors in output.

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109. Phosphorus, sediment, and E. coli loads in unfenced streams of the Georgia Piedmont, USA.

Byers, Harris L.; Cabrera, Miguel L.; Matthews, Monte K.; Franklin, Dorcas H.; Andrae, John G.; Radcliffe, David E.; Mccann, Mark A.; Kuykendall, Holli A.; Hoveland, Carl S.; and Calvert, Vaughn H.

In: Proceedings of the 2005 Georgia Water Resources Conference. Hatcher, K. J. (eds.)

Athens, GA: University of Georgia Institute of Ecology; 2005.

Notes: Conference: 2005 Georgia Water Resources Conf., Athens, GA (USA), 25-27 Apr 2005; ISBN: 0935835091

Descriptors: pathogenic bacteria/ microbial contamination/ biological pollutants/ sediment pollution/ water resources/ water quality/ water supply/ agricultural pollution/ sediment transport/ phosphorus/ environmental effects/ stream pollution/ water pollution sources/ bacteria (*Enterobacteriaceae*) (*Escherichia*)/ sediment contamination/ pastures/ cattle/ animal wastes/ agricultural runoff/ storm runoff/ grazing/ surface water/ sediment load/ pollution load/ *Escherichia coli*/ USA, Georgia

Abstract: Contamination of unfenced streams with phosphorus, sediments, and pathogenic bacteria from cattle activity may be affected by the availability of shade and alternative water sources. The objectives of this study were to evaluate water quality in two streams draining tall fescue/bermudagrass pastures with different shade distributions, and to quantify the effects of alternative water sources on stream water quality. Loads of DRP, TP, and TSS were measured during storm flow, and loads of DRP, TP, TSS, and E.coli were measured every 14 d during base flow in two streams located in the Piedmont region of Georgia. Our results showed that grazing cattle in pastures with unfenced streams contributed significant loads of DRP, TP, TSS, and E. coli to surface waters (p<0.01). Although storm flow was similar in both streams, loads of DRP, TP, and TSS were larger (p< 0.08) in the pasture with the smaller amount of non-riparian shade. Water trough availability significantly decreased (p< 0.08) base flow loads of TSS and E. coli in both streams. Our results indicate that possible BMPs to reduce P, sediment, and E.

coli contamination from beef-cattle-grazed pastures may be to develop or encourage non-riparian shade and to provide cattle with an alternative water supply away from the stream.

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110. The potential of off-stream livestock watering to reduce water quality impacts.

Godwin, Derek C. and Miner, J. Ronald
Bioresource Technology 58(3): 285-290. (1996)
NAL Call #: TD930.A32; ISSN: 0960-8524

Descriptors: animal enterprises/ animal husbandry/ animal operated pasture pump/ biobusiness/ conventional watering systems/ livestock grazing/ manure management/ off stream livestock watering/ off stream watering device/ pollution/ water quality

Abstract: Small commercial and non-commercial animal enterprises (SCAEs) are often located in suburban watersheds. Such operations raise a small number of animals on a few acres and have potential water quality impacts from their manure management. A typical pollution abatement practice includes fencing livestock from streams and providing an off-stream watering area. However, if there is a large stream to land area ratio, this practice becomes very costly for implementation and maintenance. An alternative is to provide off-stream watering areas without fencing to lure animals from the stream. This project demonstrated that off-stream watering areas are an effective alternative to stream fencing. They reduce the time animals spend at the stream under small acreage grazing conditions. In addition, an animal-operated pasture pump was demonstrated to be a viable off-stream watering device. The animal-operated tested pump pulled water from the creek and held the water in a small basin accessible to the animals. It is a usable alternative where conventional watering systems are inconvenient or expensive.

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111. Quality of runoff from plots with simulated grazing.

Edwards, D. R.; Hutchens, T. K.; Rhodes, R. W.; Larson, B. T.; and Dunn, L.

Journal of the American Water Resources Association 36(5): 1063-1074. (2000)

NAL Call #: GB651.W315; ISSN: 1093-474X

Descriptors: runoff/ grazing/ livestock/ nonpoint pollution sources/ pastures/ nutrients/ agriculture/ nitrogen/ phosphorus/ livestock (see also individual animals)/ pollution (nonpoint sources)/ land (grass and pasture)/ USA, Kentucky

Abstract: Grazed pastures represent a potential source of nonpoint pollution. In comparison to other nonpoint sources (e.g., row-cropped lands), relatively little information exists regarding possible magnitudes of nutrient losses from grazed pasture, how those losses are affected by management variables, and how the losses can be minimized. The objective of this study was to measure concentrations of nitrogen (N), phosphorus (P), and solids in runoff from fescue plots and relate those measurements to simulated forage management strategy. The study was conducted at the University of Kentucky Maine Chance Agricultural Experiment Station north of Lexington. Plots (2.4 m wide by 6.1 m long) were constructed and established in Kentucky 31 fescue (*Festuca arundinacea* Schreb.) to represent pasture. The experimental treatments

applied to the plots varied in terms of forage height and material applied (none, manure, or manure and urine). Runoff was sampled for six simulated rainfall events applied over the summer of 1997 and analyzed for nitrate N (NO₃-N), ammonia N (NH₃-N), total Kjeldahl N (TKN), ortho-P (PO₄-P), total P (TP), and total suspended solids (TSS). All runoff constituents exhibited dependence on the date of simulated rainfall with generally higher concentrations measured when simulated rainfall followed relatively dry periods. The effects of forage height and manure addition were mixed. Highest runoff N concentrations were associated with the greatest forage heights, whereas highest P concentrations occurred for the least forage heights. Manure/urine addition increased runoff P concentrations relative to controls (no manure/urine) for both the greatest and least forage heights, but runoff N concentrations were increased only for the greatest forage heights. These findings indicate that runoff N and P is at least as sensitive to amount and proximity of preceding rainfall and suggest that managing forage to stimulate growth and plant uptake can reduce runoff of N.

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112. Quantification and simulation of surface runoff from fescue grassland watersheds.

Chanasyk, D. S.; Mapfumo, E.; and Willms, W. *Agricultural Water Management* 59(2): 137-153. (2003)
 NAL Call #: S494.5.W3A3; ISSN: 0378-3774
 Descriptors: erosion/ grasslands/ grazing intensity/ losses from soil/ meltwater/ precipitation/ runoff/ simulation models/ topography/ watersheds
 Abstract: The topographic features of the foothills fescue grasslands in southern Alberta predispose them to runoff and soil loss via erosion. A study was conducted at Stavely Research Station, Alberta to determine the runoff from small grassland watersheds under three grazing intensities, viz. ungrazed (or control), heavy (2.4 animal unit months per hectare (AUM ha⁻¹)) and very heavy (4.8 AUM ha⁻¹) grazing. Total annual precipitation in 1998, 1999 and 2000 was 648, 399 and 263 mm, respectively. Surface runoff hydrographs indicated large summer storm runoff rates from heavy grazed compared to other watersheds, but large snow melt-induced runoff from very heavy grazed compared to other watersheds. Surface runoff rates measured from May and August ranged between 0 and 2.3 mm per day in 1998, 0-0.2 mm per day in 1999, and 0-0.07 mm per day in 2000. In all the years, the average rainfall runoff was <10% of average daily precipitation on all three watersheds. In 2000, snow melt-induced runoff was measured in March. Total surface runoff for this month was 0.07, 8.5 and 3.7 mm for ungrazed, heavy and very heavy watersheds, respectively. These accounted for 78, 96 and 92% of total annual runoff from ungrazed, heavy and very heavy watersheds, respectively. Surface runoff for 1999 and 2000 was simulated using Soil Water Assessment Tool (SWAT), a continuous time distributed parameter model developed for ungaged basins. Model calibration was conducted using data of 1998 and parameters adjusted until the predicted and observed results were visibly close. Evaluation of the model was conducted using statistical criteria that included calculations of average error (AE), residual mean square (RMS), coefficient of residual mass (CRM) and modelling efficiency (EF), and comparing these

statistics against optimal values. The evaluation indicated that the model under-predicted surface runoff from the watersheds in both the years.

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113. Rapid intrinsic rates of amino acid biodegradation in soils are unaffected by agricultural management strategy.

Jones, D. L.; Kemmitt, S. J.; Wright, D.; Cuttle, S. P.; Bol, R.; and Edwards, A. C. *Soil Biology and Biochemistry* 37(7): 1267-1275. (July 2005)
 NAL Call #: S592.7.A1S6; ISSN: 0038-0717
 Descriptors: agricultural soils/ grassland soils/ arable soils/ amino acids/ biodegradation/ mineralization/ fertilizer application/ grazing/ soil pH/ liming/ soil types/ soil microorganisms/ microbial activity/ biodiversity/ community structure/ soil quality/ field experimentation/ England/ Scotland/ Wales
 Abstract: Amino acids represent one of the largest inputs of dissolved organic nitrogen to soil and consequently they constitute a major component of the organic N cycle. The effect of agricultural management on the rate of amino acid turnover in soil, however, remains largely unknown. The aim of this study was to evaluate in long-term field experiments the effect of fertilizer addition (N, P and K), grazing, pH manipulation (lime addition), vegetation cover and shifts (grassland versus arable) and drainage on the mineralization of ¹⁴C-labelled amino acids in agricultural topsoils. Our results showed that the intrinsic rate of amino acid mineralization was rapid for all management regimes, irrespective of the tested soil type. The average (+/-SEM) half-life of the amino acids in all soils (n=155) was calculated to be 2.3+/-0.5 h. The relative amount of amino acid-C partitioned into respiration (25% of total C) versus biomass production (75% of total C) was also unaffected by management strategy. The rate of amino acid mineralization was shown to be slightly sensitive to soil pH, peaking at around pH(CaCl₂) 5.0 with an approximate twofold reduction at the pH extremes (pH 3.8 and 6.4). We conclude that management regime has little effect on the intrinsic rate of amino acid mineralization in agricultural soils. We propose therefore that total microbial activity rather than microbial diversity or community structure is likely to be the key determinant governing amino acid turnover in agricultural soils.
 This citation is from AGRICOLA.

114. Reducing environmental impacts of agriculture by using a fine particle suspension nitrification inhibitor to decrease nitrate leaching from grazed pastures.

Di, H. J. and Cameron, K. C. *Agriculture, Ecosystems & Environment* 109(3-4): 202-212. (2005)
 NAL Call #: S601.A34; ISSN: 0167-8809
 Descriptors: soil monolith lysimeter: field equipment/ environmental impact/ grazed pasture/ agronomic benefit/ fine particle suspension
 Abstract: Nitrate (NO₃-) leaching from intensively grazed pasture systems, e.g. dairy farming, is of increasing environmental concern worldwide. The major source of the NO₃- leached in grazed pastures is the nitrogen (N) returned in the urine from the grazing animal. The objective of this study was to use undisturbed soil monolith lysimeters to quantify the effectiveness of treating a grazed

pasture soil with a fine particle suspension (FPS) nitrification inhibitor, dicyandiamide (DCD), in decreasing NO₃- leaching losses from a deep sandy soil with a mixture of perennial ryegrass (*Lolium perenne* L.) and white clover (*Trifolium repens* L.) pasture. The application of DCD as a FPS at 10 kg ha⁻¹ in autumn (May) and late winter (August) decreased NO₃-N leaching from 134 kg N ha⁻¹ year 1 to 43 kg N ha⁻¹ year 1 (equivalent to a 68% reduction) from the dairy cow urine N applied in the autumn (May) at the rate of 1000 kg N ha⁻¹. This reduced the annual average NO₃-N concentration under the urine patch from 43 mg NO₃-N L⁻¹ to 18 mg NO₃-N L⁻¹. The DCD FPS also reduced Ca²⁺ leaching by 51% and Mg²⁺ leaching by 31%. In addition, herbage dry matter yield in the urine patch areas was increased by 33%, from 15.3 t ha⁻¹ year⁻¹ without DCD to 20.3 t ha⁻¹ year⁻¹ when DCD was applied at 10 kg ha⁻¹. However, DCD applied at 5 kg ha⁻¹ (May and August) did not provide significant environmental and agronomic benefits under the experimental conditions. Results from this study when compared with those reported previously show that DCD, when applied as a FPS at 10 kg active ingredient ha⁻¹, is just as effective in reducing NO₃- leaching in grazed pasture soils, as when it is applied as a solution. (c) 2005 Elsevier B.V. All rights reserved.
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115. Reduction of nitrate leaching with haying or grazing and omission of nitrogen fertilizer.

Owens, L. B. and Bonta, J. V.
Journal of Environmental Quality 33(4): 1230-1237. (2004)
NAL Call #: QH540.J6; ISSN: 0047-2425
Descriptors: haying: applied and field techniques/ rotational grazing: applied and field techniques/ alternative management practices/ groundwater/ high fertility high stocking density grazing systems/ small watersheds
Abstract: In some high-fertility, high-stocking-density grazing systems, nitrate (NO₃) leaching can be great, and ground water NO₃-N concentrations can exceed maximum contaminant levels. To reduce high N leaching losses and concentrations, alternative management practices need to be used. At the North Appalachian Experimental Watershed near Coshocton, OH, two management practices were studied with regard to reducing NO₃-N concentrations in ground water. This was following a fertilized, rotational grazing management practice from which ground water NO₃-N concentrations exceeded maximum contaminant levels. Using four small watersheds (each approximately 1 ha), rotational grazing of a grass forage without N fertilizer being applied and unfertilized grass forage removed as hay were used as alternative management practices to the previous fertilized pastures. Ground water was sampled at spring developments, which drained the watershed areas, over a 7-yr period. Peak ground water NO₃-N concentrations before the 7-yr study period ranged from 13 to 25.5 mg L⁻¹. Ground water NO₃-N concentrations progressively decreased under each watershed and both management practices. Following five years of the alternative management practices, ground water NO₃-N concentrations ranged from 2.1 to 3.9 mg L⁻¹. Both grazing and haying, without N fertilizer being applied to the forage, were similarly effective in reducing the NO₃-N levels in ground water. This research shows two management practices that can be effective in reducing high NO₃-N

concentrations resulting from high-fertility, high-stocking density grazing systems, including an option to continue grazing.

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116. Responses of fecal coliform in streamwater to four grazing strategies.

Tiedemann, A. R.; Higgins, D.; Quigley, T. M.; Sanderson, H. R.; and Marx, D. B.
Journal of Range Management 40(4): 322-329. (1987)
NAL Call #: 60.18 J82; ISSN: 0022-409X
<http://jrm.library.arizona.edu/data/1987/404/9tied.pdf>
Descriptors: bacterial/ water/ contamination/ livestock distribution/ pastures/ watersheds/ pollution
Abstract: Concentration and loadings (output, number day⁻¹ km⁻²) of fecal coliform (FC) indicator bacteria were measured from 1979 through 1984 in streamflow from 13 forested watersheds under the following range management strategies: (A) no grazing; (B) grazing without management for livestock distribution; (C) grazing with management to obtain livestock distribution, and (D) grazing with management to obtain livestock distribution and cultural practices to increase forage. Both FC concentration (number/100 ml) and instantaneous loadings differed significantly among strategies, seasons, and water years. Differences among strategies for mean concentrations were A < C = B < D. For instantaneous loadings, significant differences were A < C, B or D; and C < D. FC concentration were the same for winter and for snowmelt runoff seasons but concentration of both were significantly lower than during the summer period. Loadings were different for each season with winter < summer < snowmelt runoff. A definite relationship was established between the presence of cattle on the pastures and FC concentrations. Elevated FC counts in strategy D watersheds and loadings in excess of 108 organisms day⁻¹ km⁻² in the winter season provide evidence that organisms live into and through the winter period in animal feces, sediment, and soil. Results provide evidence that livestock removal may not provide an immediate solution to elevated levels of FC in streamwater.
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117. Restricting the grazing time of cattle to decrease phosphorus, sediment and E. coli losses in overland flow from cropland.

McDowell, R. W.; Drewry, J. J.; Muirhead, R. W.; and Paton, R. J.
Australian Journal of Soil Research 43(1): 61-66. (2005)
NAL Call #: 56.8 Au7; ISSN: 0004-9573
Descriptors: *Escherichia coli*/ grazing/ particulate P/ pasture/ treading
Abstract: This study investigated the effects of grazing management of brassica crops during winter on soil physical properties and sediment, phosphorus (P), and *E. coli* loss via overland flow. Dairy cows were allowed either unrestricted grazing, grazing restricted to 3 h, or no grazing. Treading in the unrestricted treatment decreased soil bulk density and saturated hydraulic conductivity (K_{sat}), and increased surface roughness, loads and concentrations of suspended sediment, and *E. coli* and P loss in overland flow relative to the ungrazed treatment. Only bulk density was different in the restricted compared with the ungrazed treatment. For total P, the mean load in overland flow from the unrestricted grazing treatment after grazing was 3.31

mg/plot compared with restricted grazing (0.74 mg/plot) and ungrazed (0.76 mg/plot) treatments, with most of the increase in particulate form. E. coli concentrations only exceeded water quality guidelines in the first event after grazing, and only in the unrestricted grazing treatment. We found that restricting grazing on forage crops during winter was beneficial for minimising contaminant loss. © CSIRO 2005.

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118. Runoff and sediment losses resulting from winter feeding on pastures.

Owens, L. B.; Edwards, W. M.; and Van Keuren, R. W. *Journal of Soil and Water Conservation* 52(3): 194-197. (1997)

NAL Call #: 56.8 J822; ISSN: 0022-4561

Descriptors: pastures/ runoff/ sediment erosion/ grazing/ small watersheds/ cattle/ sediments/ erosion/ watersheds/ agricultural runoff/ USA, Ohio/ pasture/ pastures/ sediment erosion/ grazing/ small watersheds

Abstract: Grazing is an important land use in the humid, eastern U.S. When the grass is dormant, late fall through early spring, the land is most vulnerable to the pressures of livestock. Runoff and sediment losses from a small pastured watershed (WS) in eastern Ohio have been studied for 20 years. In Period 1, a beef cow herd grazed it rotationally during the growing season for 12 years and was fed hay in this WS during the dormant season (high animal density with feeding). During the next 3 years of this study (Period 2), there was summer rotational grazing only. There was no animal occupancy on this WS during the last 5 years (Period 3). Annual runoff was more than 10% of precipitation during Period 1 (120 mm) and less than 2% during Periods 2 and 3 (14 and 6 mm, respectively). The decrease in annual sediment loss was even greater with the change in management, yielding 2259, 146, and 9 kg/ha for the three respective periods. Over 60% of the soil loss during Period 1 occurred during the dormant season. In response to weather inputs, there was considerable seasonal and annual variation in runoff and soil loss within management periods. Low amounts of runoff and erosion from three adjacent watersheds with summer-only grazing supported the conclusion that the increased runoff and erosion during Period 1 resulted from the non-rotational, winter feeding on pastures. When the management was changed, the impacts of the previous treatment were not long lasting, changing within a year.

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119. Runoff and sediment yield from snowmelt and rainfall as influenced by forage type and grazing intensity.

Gill, S. I.; Naeth, M. A.; Chanasyk, D. S.; and Baron, V. S. *Canadian Journal of Soil Science* 78(4): 699-706. (1998)

NAL Call #: 56.8 C162; ISSN: 0008-4271

Descriptors: runoff/ sediment yield/ erosion/ grasslands/ meltwater/ rain/ forage/ fodder plants/ barley/ triticale/ grazing

Abstract: A study to examine the runoff and sediment yields of annual and perennial forages in central Alberta, Canada, was initiated in 1994. Runoff and sediment yield were quantified under snowmelt and rainfall events for two seasons. Rainfall simulation was used to further examine runoff under growing season conditions. Four forage treatments [two annuals: Pika triticale (x Triticosecale) and

a barley/Pika triticale mixture and two perennials: Carlton smooth brome grass and Paddock meadow brome grass (Bromus riparius)] and three grazing intensities (light, medium and heavy) were studied, each replicated four times. Total annual runoff was dominated by snowmelt. Generally runoff volumes, sediment yields, sediment ratios and runoff coefficients were all low. Bare ground increased with increasing grazing intensity and was significantly greater in annuals than perennials for all grazing intensities. Litter biomass decreased with increasing grazing intensity and was generally similar in all species for both years at heavy and medium grazing intensities. Results from the rainfall simulation corroborated those under natural rainfall conditions and generally indicated the sustainability of these grazing systems at this site.

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120. Seasonality of the soil biota of grazed and ungrazed hill grasslands.

Bardgett, R. D.; Leemans, D. K.; Cook, R.; and Hobbs, P. J. *Soil Biology and Biochemistry* 29(8): 1285-1294. (1997)

NAL Call #: S592.7.A1S6; ISSN: 0038-0717

Descriptors: animals and man/ disturbance by man/ commercial activities/ ecology/ habitat/ terrestrial habitat/ land and freshwater zones/ Palaeartic Region/ Europe/ United Kingdom/ Nematoda: farming and agriculture/ cattle grazing effects on hill grassland soil communities/ community structure/ grassland soil habitat/ grassland/ soil community structure/ soil habitat/ grasslands/ Wales/ Snowdonia National Park/ grassland soil community structure/ effects of cattle grazing/ Nematoda/ helminths/ invertebrates/ nematodes

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121. Sediment and nutrient losses from an unimproved, all-year grazed watershed.

Owens, L. B.; Edwards, W. M.; and Van Keuren, R. W. *Journal of Environmental Quality* 18(2): 232-238. (1989)

NAL Call #: QH540.J6; ISSN: 0047-2425

Descriptors: nutrients/ water quality/ nutrient loss/ pasture/ grazing/ watersheds/ livestock/ agricultural pollution/ USA, Ohio/ sedimentation/ effects on/ Ohio

Abstract: A common practice for grazing land in the humid, eastern USA is continuous grazing with little or no fertilizer use. Concentrations and transport of nutrients from a 28-ha unimproved grassed watershed were assessed in east-central Ohio for 2 yr without the presence of livestock, for 3 yr with a 17-cow beef (Bos taurus) herd grazing during the summer months only, and for an additional 6-yr period with all-year grazing with hay being brought in for winter feed. Nutrient concentrations remained low during all three grazing levels. An exception was K concentration, which increased with all-year grazing. All-year cattle grazing/feeding on an unimproved pasture in this area would not be expected to produce degradation of stream water quality from nutrient concentrations or transport.

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122. Sediment losses from a pastured watershed before and after stream fencing.

Owens, L. B.; Edwards, W. M.; and Van Keuren, R. W.

Journal of Soil and Water Conservation 51(1):

90-94. (1996)

NAL Call #: 56.8 J822; ISSN: 0022-4561

Descriptors: grazing/ sediment erosion/ livestock/ grasslands/ pastures/ fences/ agricultural watersheds/ USA, Ohio, Coshocton

Abstract: Livestock induced sediment loss is one of the potential detrimental impacts from grazing grasslands. Near Coshocton, Ohio, a 26-ha unimproved pasture watershed was grazed year-around, and no fertilizer was applied. A beef cow herd had access to the entire watershed area including the small stream that originated within the watershed, i.e. there was no rotational grazing in the pasture. Sediment loss via the stream was measured at the base of the watershed. Following 7 years of this management practice, the stream and the wooded areas on the sides of the stream were fenced so that the cattle no longer had access to them. During the next 5 years, with the cattle fenced out of the stream, the annual sediment concentration decreased by more than 50% and the amount of soil lost decreased by 40%. Average annual soil losses were reduced from 2.5 to 1.4 Mg/ha while annual precipitation averages were similar during each management period.

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123. SGS Water Theme: Influence of soil, pasture type and management on water use in grazing systems across the high rainfall zone of southern Australia.

White, R. E.; Christy, B. P.; Ridley, A. M.; Okom, A. E.; Murphy, S. R.; Johnston, W. H.; Michalk, D. L.; Sanford, P.; McCaskill, M. R.; Johnson, I. R.; Garden, D. L.; Hall, D. J. M.; and Andrew, M. H.

Australian Journal of Experimental Agriculture 43(7/8): 907-926. (2003)

NAL Call #: 23 Au792; ISSN: 0816-1089

Descriptors: Alfisols/ Aridisols/ fertilizers/ grassland management/ grasslands/ grazing/ natural grasslands/ plant water relations/ rotational grazing/ soil types/ soil water balance/ soil water movement/ sown grasslands/ stocking rate/ Ultisols/ water deficit/ water use

Abstract: Eleven experimental sites in the Sustainable Grazing Systems (SGS) national experiment were established in the high rainfall zone (HRZ, >600 mm/year) of Western Australia, Victoria and New South Wales to measure components of the water balance, and pathways of water movement, for a range of pastures from 1997 to 2001. The effect of widely spaced river red gums (*Eucalyptus camaldulensis*) in pasture, and of belts of plantation blue gums (*E. globulus*), was studied at 2 of the sites. The soil types tested ranged from Kurosols, Chromosols and Sodosols, with different subsoil permeabilities, to Hydrosols and Tenosols. The pasture types tested were kikuyu (*Pennisetum clandestinum*), phalaris (*Phalaris aquatica*), redgrass (*Bothriochloa macra*) and annual ryegrass (*Lolium rigidum*), with subterranean clover (*Trifolium subterraneum*) included. Management variables were set stocking v. rotational grazing, adjustable stocking rates, and level of fertiliser input. Soil, pasture and animal measurements were used to set parameters for the biophysical SGS pasture model, which simulated the long-term effects of soil, pasture type, grazing method and

management on water use and movement, using as inputs daily weather data for 31 years from selected sites representing a range of climates. Measurements of mean maximum soil water deficit were used to estimate the probability of surplus water occurring in winter, and the average amount of this surplus, which was highest (97-201 mm/year) for pastures in the cooler, winter-rainfall dominant regions of north-east and western Victoria and lowest (3-11 mm/year) in the warmer, lower rainfall regions of the eastern Riverina and Esperance, Western Australia. Kikuyu in Western Australia achieved the largest increase in Sm compared with annual pasture (55-71 mm), while increases due to phalaris were 18-45 mm, and those of native perennials were small and variable. Long-term model simulations suggested rooting depth was crucial in decreasing deep drainage, to about 50 mm/year for kikuyu rooting to 2.5 m, compared with 70-200 mm/year for annuals rooting to only 0.8 m. Plantation blue gums dried the soil profile to 5.25 m by an average of 400 mm more than kikuyu pasture, reducing the probability of winter surplus water to zero, and eliminating drainage below the root zone. Widely spaced river red gums had a much smaller effect on water use, and would need to number at least 14 trees per hectare to achieve extra soil drying of about 50 mm over a catchment. Soil type affected water use primarily through controlling the rooting depth of the vegetation, but it also changed the partitioning of surplus water between runoff and deep drainage. Strongly duplex soils such as Sodosols shed 50% or more surplus water as runoff, which is important for flushing streams, provided the water is of good quality. Grazing method and pasture management had only a marginal effect in increasing water use, but could have a positive effect on farm profitability through increased livestock production per hectare and improved persistence of perennial species.

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124. Short-term changes in soil nutrients and vegetation biomass and nutrient content following the introduction of extensive management in upland sown swards in Scotland, UK.

Marriott, Carol A.; Bolton, Geoffrey R.; Fisher, Julia M.; and Hood, Kenny

Agriculture, Ecosystems & Environment 106(4):

331-344. (2005)

NAL Call #: S601 .A34; ISSN: 0167-8809

Descriptors: grazing management/ nutrient content/ vegetation biomass

Abstract: Agri-environmental policy changes promote more extensive grazing management but the temporal responses of soil nutrients and vegetation biomass and quality to reductions in grazing intensity are still unresolved. We measured soil nutrients and the biomass and nutrient content of vegetation over 5 years following the introduction of extensive management treatments at three sites in Scotland, UK. Five unfertilised treatments, representing different levels of extensive management, were established on existing sown perennial ryegrass/white clover swards. One treatment was ungrazed (UN) and the others had sward surface height treatments of 4 or 8 cm during two grazing season treatments, summer and autumn, within each year in a factorial combination (4/4, 4/8, 8/8, 8/4 cm). A further treatment, representative of current more intensive systems, received an annual total of 140 kg N ha⁻¹ plus maintenance P and K and was grazed by sheep

to maintain a sward surface height of 4 cm (417). When compared with more intensive management, there was little effect of 5 years of extensive management on soil nutrients at any of the three sites. The extensive treatments created swards with different above-ground biomass during the season, thus changing the balance between the litter and excretal routes for the recycling of plant nutrients. When expressed relative to treatment 4F, the proportion of live dry mass and N, P and K contents in sown species was on average higher in swards maintained at 4 cm in summer than at 8 cm, and there was evidence of a decline over time in the latter treatments. The proportion of unsown species in live mass increased over time in the unfertilised treatments, and the increase was most rapid in the ungrazed treatment. Nutrient contents of the vegetation in unfertilised swards were lower than those in fertilised swards, and changes over 5 years in the different management treatments differed between sites. However nutrient contents remained above levels that could adversely affect sheep performance throughout this period. Agri-environment schemes that promote extensive grazing management will change vegetation biomass and nutrients but are unlikely to reduce soil nutrients in the short term. (c) 2004 Elsevier B.V. All rights reserved.
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125. The short-term effects of cessation of fertiliser applications, liming, and grazing on microbial biomass and activity in a reseeded upland grassland soil.

Bardgett, R. D. and Leemans, D. K.
Biology and Fertility of Soils 19(2/3): 148-154. (1995)
NAL Call #: QH84.8.B46; ISSN: 0178-2762
Descriptors: grassland soils/ *Lolium perenne*/ fertilizers/ liming/ grazing/ soil microorganisms/ biomass/ soil enzymes/ oxidoreductases/ urease/ phosphoric monoester hydrolases/ adenosine triphosphate/ soil pH/ range management/ highlands/ Wales
Abstract: A field study was conducted to determine the influence of a short-term (2 year) cessation of fertiliser applications, liming, and sheep-grazing on microbial biomass and activity in a reseeded upland grassland soil. The cessation of fertiliser applications (N and NPK) on a limed and grazed grassland had no effect on microbial biomass measurements, enzyme activities, or respiration. Withholding fertiliser and lime from a grazed grassland resulted in significant reductions in both microbial biomass C ($P < 0.05$) and dehydrogenase activity ($P < 0.05$) by approximately 18 and 21%, respectively. The removal of fertiliser applications, liming, and grazing resulted in even greater reductions in microbial biomass C (44%, $P < 0.001$) and dehydrogenase activity (31%, $P < 0.001$), and significant reductions in microbial biomass N ($P < 0.05$), urease activity ($P < 0.05$), phosphatase activity ($P < 0.001$), and basal respiration ($P < 0.05$). The abundance of culturable bacteria and fungi and the soil ATP content were unaffected by changes in grassland managements. With the cessation of liming soil pH fell from 5.4 to 4.7, and the removal of grazing resulted in a further reduction to pH 4.5. A significant negative linear relationship ($r^2 = 0.97$; $P < 0.01$) was found between increasing soil acidity and dehydrogenase activity. Possible mechanisms influencing these changes are discussed.
This citation is from AGRICOLA.

126. Simulating transport of E. coli derived from faeces of grazing livestock using the MACRO model.

McGechan, M. B. and Vinten, A. J. A.
Soil Use and Management 20(2): 195-202. (2004)
NAL Call #: S590.S68; ISSN: 0266-0032
Descriptors: *Escherichia coli*/ feces/ sheep/ coliform bacterial/ contaminants/ water pollution/ drainage water/ soil water content/ soil pore system/ soil transport processes/ simulation models/ rain
Abstract: Coliforms such as *Escherichia coli* and *E. coli* O157 are present in faeces deposited on the ground by grazing livestock, which gives rise to environmental concerns about the consequences of their transport in soil water draining to rivers, lakes, groundwater, water supplies and bathing waters. Following a similar study in relation to slurry spreading (*Soil Use and Management* 2003; 19, 321-330), a two-stage approach was adopted to using the dual-porosity contaminant transport model MACRO to simulate processes by which *E. coli* microorganisms from grazing livestock (sheep) pass through the soil to receiving waters via field drains. First, model parameter values were selected to reproduce experimental measurements showing rapid flows of the organisms by macropore flow without trapping in smaller pores. However, because of the large number of parameters and likely experimental errors, the set of values chosen, although plausible, is not necessarily unique and so any predictions should be considered provisional pending validation. Second, a series of predictive simulations was carried out to test the influence of soil and weather conditions on losses to field drains during grazing. These showed that *E. coli* losses were influenced almost entirely by the soil water content at the time of grazing, rising to a high level during grazing in wet conditions, but low or zero under dry conditions. In contrast, rainfall at the time of grazing had almost no consistent effect, other than large losses on the occasional days with over 20 mm of rain. Overall losses for a period of grazing were generally small during summer, but rose to a high level if grazing continued into autumn, due to the increase in soil water content. This demonstrates that there would probably be substantial reductions in the environmental risks of water pollution by *E. coli* and other faecal microorganisms if continuous grazing were stopped around early September and replaced by grazing on dry days only. This citation is from AGRICOLA.

127. Soil changes associated with cessation of sheep grazing in the Canterbury high country, New Zealand.

Basher, L. R. and Lynn, I. H.
New Zealand Journal of Ecology 20(2): 179-189. (1996)
NAL Call #: QH540.N43; ISSN: 0110-6465
Descriptors: high country/ indicators/ microbial carbon/ nutrients/ sustainability
Abstract: Soil characteristics were examined within and adjacent to two vegetation exclosures near Porters Pass, Canterbury retired from grazing 45 years ago. Soils were analysed for a range of simple physical (topsoil depth, bulk density), chemical (pH, exchangeable cations, P, S, total C and N) and biochemical (microbial carbon) properties to determine whether the vegetation recovery inside the exclosures was reflected in soil differences. At both sites there were few significant differences between the exclosure and the surrounding grazed area, despite vegetation recovery since exclusion of grazing. At Starvation Gully topsoil depth and Na were higher, and bulk

density, pH, K, total C, total N and microbial C mass, and the microbial C to total C ratio were lower in the enclosure. At Cloudy Knoll Ca, Mg, total C and N were higher and Na was lower in the enclosure. There was a marked contrast in the trends at the two sites, with slightly lower nutrient status and organic matter in the enclosure at Starvation Gully, and the reverse at Cloudy Knoll. The differences between the sites probably reflect differences in the partitioning of nutrients and organic matter between vegetation, litter and soil at the two sites. The results suggest a slow rate of change of soil properties following cessation of grazing and the need to sample soils, litter and vegetation when determining trends in organic matter and chemical fertility.
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128. Soil-climate effects on nitrate leaching from cattle excreta.

Stout, W. L.; Gburek, W. J.; Schnabel, R. R.; Folmar, G. J.; and Weaver, S. R.

Journal of Environmental Quality 27(5): 992-998. (1998)

NAL Call #: QH540.J6; ISSN: 0047-2425

Descriptors: leaching/ cattle/ manure/ farms/ grazing/ soil properties/ climates/ nitrates/ lysimeters/ excretory products/ soils/ agriculture/ climate/ organic wastes/ agricultural runoff/ dairies/ urine/ soil/ animal wastes/ excretion/ nitrogen/ USA, Pennsylvania/ seasonal variations/ cattle manure/ *Dactyls glomerata*

Abstract: Management intensive grazing (MIG) is a grazing system in which animals at a high stocking density are rotated through several paddocks at short time intervals (12-24 h) so that animal performance is maximized.

Although MIG has the potential to increase dairy farm profitability in the northeast USA, recent work in this region has shown that a substantial amount of N recycled through urine is leached below the root zone. How soil properties, particularly water-holding capacity, can affect NO₃-N leaching from beneath urine and feces spots under the climatic conditions of the northeast USA is not known. We conducted a field study to measure NO₃-N leaching loss from spring-, summer-, and fall-applied urine and summer applied feces beneath N-fertilized orchardgrass (*Dactyls glomerata* L., cv. Pennlate) using large drainage lysimeters installed in two soils that differed greatly in soil water storage capacity. The study sites were located in central Pennsylvania on a Hagerstown silt loam soil (fine, mixed, mesic Typic Hapludalf) and a Hartleton channery silt loam (loamy-skeletal, mixed, mesic Typic Hapludult). Compared to the Hagerstown soil, the Hartleton soil provided an 85% decrease in plant N uptake, a 52% increase in leachate volume, but no significant increase in NO₃-N leaching beneath urine spots. However, the lower soil water-holding capacity of the Hartleton soil caused the NO₃-N leaching losses to be more evenly distributed over the year.

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129. Soil compaction under grazing of annual and perennial forages.

Mapfumo, E.; Chanasyk, D. S.; Naeth, M. A.; and Baron, V. S.

Canadian Journal of Soil Science 79(1): 191-199. (1999)

NAL Call #: 56.8 C162; ISSN: 0008-4271

Descriptors: triticale/ grazing/ resistance to penetration/ compaction/ soil compaction/ trampling/ bulk density/ soil

water content/ grasslands/ seasonal variation/ environmental impact/ stocking density/ Triticosecale-wittmark

Abstract: The impact of heavy, medium and light grazing of meadow brome grass [*Bromus riparius*] and triticale on soil bulk density, relative compaction and penetration resistance was assessed at Lacombe, Alberta, Canada, on a orthic black Chernozem of loam to silt loam texture. Sampling was conducted in autumn 1995, spring and autumn 1996, and spring 1997. Core samples were collected to a 15-cm depth for measurement of bulk density and moisture content. Surface (0-2.5 cm) bulk density and penetration resistance were significantly greater under heavily grazed than under medium and lightly grazed meadow brome grass for autumn 1995. Differences in bulk density, relative compaction and penetration resistance for different grazing intensities in spring and autumn 1996 and spring 1997 were not significant. Bulk density decreased over winter in the top 2.5 cm, was not consistent in the 5-10 cm depth interval, and did not change in the 10-15 cm interval. Except for autumn 1995, the relative compaction values for all grazing intensities and forage species were <90%, a value considered critical for plant growth. Generally, within each grazing level, there were minimal differences in bulk density, relative compaction and penetration resistance under triticale compared to those under meadow brome grass.
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130. Soil compaction versus cow-stocking rates on an irrigated grazing system.

Silva, A. P.; Imhoff, S.; and Corsi, M.

Advances in Geoecology(35): 397-406. (2002);

ISSN: 0722-0723

Descriptors: cows/ grazing systems/ irrigated pastures/ soil compaction/ soil physical properties/ soil strength/ soil water/ stocking rate/ trampling/ soil-quality

Abstract: Reduction in pasture productivity is generally attributed to alterations in soil quality. Soil compaction due to animal trampling is one of the factors responsible for the degradation of the physical quality of soils under pasture. The objective of this study was to evaluate soil compaction by determining soil strength in an irrigated short-duration grazing system at three cow-stocking rates. The study was carried out at the ESALQ experimental station (University of Sao Paulo, Brazil), where an irrigated short-duration grazing system was established. Simultaneous measurements of soil strength and moisture were made in plots submitted to three cow-stocking rates: 5.68 animal units (AU) ha⁻¹, 4.42 AU ha⁻¹, and 3.50 AU ha⁻¹. The influence of soil moisture on soil strength was taken into account using regression analysis techniques. After this procedure, the results showed that soil strength was significantly higher for the treatment that employed the highest cow-stocking rate, while similar values were obtained for the other two treatments.

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131. Soil contamination of plant surfaces from grazing and rainfall interactions.

Hinton, T. G.; Stoll, J. M.; and Tobler, L.

Journal of Environmental Radioactivity 29(1): 11-26. (1995)

NAL Call #: QH543.5.A1; ISSN: 0265-931X

Descriptors: environmental transport/ grazing density/ radioactive pollution/ scandium/ soil movement

Abstract: Contaminants often attach to soil particles, and their subsequent environmental transport is largely determined by processes that govern soil movement. We examined the influence of grazing intensity on soil contamination of pastures. Four different grazing densities of sheep were tested against an ungrazed control plot. Scandium concentrations were determined by neutron activation analysis and was used as a tracer of soil adhesion on vegetation. Soil loadings (g soil kg⁻¹ dry plant) increased 60% when grazing intensity was increased by a factor of four ($p = 0.003$). Rain and wind removed soil from vegetation in the ungrazed control plots, but when grazing sheep were present, an increase in rain from 0.3 to 9.7 mm caused a 130% increase in soil contamination. Multiple regression was used to develop an equation that predicts soil loadings as a function of grazing density, rainfall and wind speed ($p = 0.0001$, $r^2 = 0.78$). The model predicts that if grazing management were to be used as a tool to reduce contaminant intake from inadvertent consumption of resuspended soil by grazing animals, grazing densities would have to be reduced 2-5 times to reduce soil loadings by 50%.

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132. Soil derived phosphorus in surface runoff from grazed grassland lysimeters.

Haygarth, P. M. and Jarvis, S. C.

Water Research 31(1): 140-148. (1997)

NAL Call #: TD420.W3; ISSN: 0043-1354

Descriptors: fertilizers/ lysimeters/ phosphorus/ surface runoff/ monitoring/ grasslands/ grazing/ cattle/ rainfall intensity/ water pollution sources/ soil environment

Abstract: Seven 1 ha grazed lysimeter plots, managed as intensive grassland for the last 12 years, were monitored for total phosphorus (TP) and molybdate reactive phosphorus (MRP) in surface runoff plus interflow to 30 cm depth, for up to ten events during 1994. The mean MRP and TP concentrations determined were 40 and 122 $\mu\text{g l}^{-1}$ super(-1), respectively, but the data were heavily skewed by low frequency high intensity events. Thus concentrations of MRP and TP of over 1200 and 1700 $\mu\text{g l}^{-1}$ super(-1) respectively were determined in extreme events, causing a TP export of up to 18 g ha super(-1) per h and, during one event of 30 h duration, over 0.5 kg TP ha super(-1) was estimated to have been removed, representing a significant proportion of the triple super phosphate fertiliser added 6 days earlier. One storm was monitored at 3 h intervals and the patterns for TP concentration and TP load were closely related to discharge. MRP concentration did not follow the hydrographic pattern. Excluding the low frequency high intensity events, an empirical model TP ($\mu\text{g l}^{-1}$ super(-1)) = $58 + [42 \times \text{discharge}]$ (l s^{-1} super(-1)) was postulated, which although significant ($P = 0.0053$), only accounted for 14% of the relationship. It was thus concluded that understanding of release mechanisms in the majority of high frequency, low intensity events is inadequate. Conversely, during one period of high phosphorus (P) export, the mechanisms responsible were suggested to be a combination of the presence of cattle (excretal returns and poaching), timing of inorganic P fertiliser additions, and intensity of rainfall. Grassland soils are a significant source of diffuse P inputs to surface and estuarine waters and may cause eutrophication.

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133. Soil hydrologic response to number of pastures and stocking density under intensive rotation grazing.

Warren, S. D.; Blackburn, W. H.; and Taylor, C. A.

Journal of Range Management 39(6): 500-504. (1986)

NAL Call #: 60.18 J82; ISSN: 0022-409X

<http://jrm.library.arizona.edu/data/1986/396/5warr.pdf>

Descriptors: livestock/ infiltration rate/ sediment production/ sediment loss/ rest period

Abstract: Infiltration rate and sediment production was measured for 2 years on 3 pastures from an intensive rotational grazing system. The pastures were 32, 24, and 16 ha in size. Stocking rate was held constant but stocking density at any given point in time varied due to pasture size. Stocking densities were 0.68, 0.51, and 0.32 ha/AU, respectively. Within the respective treatments, midgrass interspaces exhibited significantly higher infiltration rates and lower sediment production than shortgrass interspaces. Overall, the pasture grazed at the highest stocking density produced the lowest infiltration rates and the greatest sediment loss. However, there was no consistent trend in hydrologic responses over time and the differences appeared to be the result of random selection of a poorer condition site on 1 or 2 occasions rather than the result of stocking density. Regardless of whether the pasture grazed at the highest stocking density was in similar or poorer hydrologic condition in terms of treatment response, the data do not support the hypothesized beneficial hydrologic advantages of increased stocking density via manipulation of pasture size and numbers. Rest, rather than intensive livestock activity, appears to be the key to soil hydrologic stability. The potential for altering the length of the rest period is greatest where the number of pastures is small. Therefore, very little benefit in terms of soil hydrologic condition should be expected from large increases in the number of pastures within rotational grazing systems.

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134. Soil macronutrient distribution in rotationally stocked kikuyugrass paddocks with short and long grazing periods.

Mathews, B. W.; Tritschler, J. P.; Carpenter, J. R.; and Sollenberger, L. E.

Communications in Soil Science and Plant Analysis 30(3-4): 557-571. (1999)

NAL Call #: S590.C63; ISSN: 0010-3624

Descriptors: grazing period length/ kikuyugrass paddock rotational stocking

Abstract: Grazing management affects plant growth and animal production and it may influence the redistribution and cycling of nutrients excreted in dung and urine. Unfortunately, the soil component of pasture systems has received little attention in most grazing trials, and when considered has been evaluated on pastures smaller than those used commercially. A naturalized kikuyu (*Pennisetum clandestinum* Hochst. ex Chiov.) grassland was grazed by heifers (*Bos taurus*) for 2 yr in Experiment 1 to determine the effects of two rotational stocking methods (short vs. long grazing periods) on soil distribution of extractable nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and sulfur (S) in 4-ha paddocks with natural shade. Additionally, in Experiment 2, kikuyugrass-greenleaf desmodium (*Desmodium intortum* Urb.) paddocks were used to evaluate the effect of distance from waterers on soil nutrient distribution in rotationally stocked paddocks (long grazing periods) without shade in a cooler,

higher elevation, environment. In Experiment 1, soil N, P, and K distribution did not differ between lengths of grazing period when assessed using a zonal soil sampling procedure with zones based on distance from shade and water sources. These nutrients, and in particular K, accumulated within 15 m of shade, but did not accumulate significantly around waterers. In Experiment 2, zonal soil sampling indicated that P, Mg, and especially K, accumulated within 15 m of the waterer. In both studies, extractable K data collected via a grid sampling regime and contour maps constructed from these data supported, in general, the conclusions made using zonal sampling. It is suggested that in this subtropical environment the magnitude of excretal N, P, and K accumulation is greater around shade than waterers, and that in paddocks without shade substantial amounts of P and K accumulate near the waterer. As with small paddocks/pastures, zonal soil sampling appears to be a practical sampling strategy for large paddocks (4 ha).

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135. Soil microbial biomass, C and N mineralization, and enzyme activities in a hill pasture: Influence of grazing management.

Ross, D. J.; Speir, T. W.; Kettles, H. A.; Tate, K. R.; and Mackay, A. D.

Australian Journal of Soil Research 33(6): 943-959. (1995)
NAL Call #: 56.8 Au7; ISSN: 0004-9573

Descriptors: carbon/ elemental sulfur/ fertilizer/ nitrogen/ nutrient cycle/ plant growth/ rock phosphate/ typic Dystrachrept

Abstract: Grazing and fertilizer management practices are of prime importance for maintaining summer-moist hill pastures of introduced grasses and clovers in New Zealand for sheep and cattle production. The influence of withholding grazing (a pastoral fallow) from spring to late summer on microbial biomass, C and N mineralization, and enzyme activities was investigated in a Typic Dystrachrept soil from unfertilized and fertilized (rock phosphate and elemental S) low-fertility pastures at a temperate hill site. The fallow increased pasture but not legume growth in the following year in the unfertilized treatment, but had no effect on pasture or legume growth in fertilized plots. High background levels of the biochemical properties examined, and very variable rates of N mineralization, complicated data interpretation. Extractable-C concentration and CO₂-C production were enhanced at the completion of the fallow. Increases in net N mineralization (14-56 days incubation), following initial immobilization, after the fallow were clearly indicated in the unfertilized treatment, but were less distinct in the fertilized treatment. The fallow had no detectable influence on the concentrations of total C and N or microbial C and P, or on invertase, phosphodiesterase and sulfatase activities. Some small changes in microbial N and an increased proportion of bacteria in the microbial population were, however, suggested. Results are consistent with the concept of fallowing giving a short-term increase in pools of readily decomposable soil organic matter. Generally, the changes that did occur in these soil biochemical properties are, with the partial exception of increased N availability, unlikely to have had any pronounced impact on subsequent pasture performance.

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136. Soil organic C and N pools under long-term pasture management in the Southern Piedmont USA.

Franzleubbers, A. J.; Stuedemann, J. A.; Schomberg, H. H.; and Wilkinson, S. R.

Soil Biology and Biochemistry 32(4): 469-478. (2000)
NAL Call #: S592.7.A1S6; ISSN: 0038-0717

Descriptors: pastures/ range management/ grazing/ botanical composition/ age/ land use/ soil organic matter/ carbon/ nitrogen/ soil microorganisms/ biomass/ grassland soils/ forest soils/ agricultural soils/ Georgia
Abstract: Soil organic matter pools under contrasting long-term management systems provide insight into potentials for sequestering soil C, sustaining soil fertility and functioning of the soil-atmospheric interface. We compared soil C and N pools (total, particulate and microbial) under pastures (1) varying due to harvest technique (grazing or haying), species composition (cool- or warm-season), stand age and previous land use and (2) in comparison with other land uses. Grazed tall fescue-common bermudagrass pasture (20 yr old) had greater soil organic C (31%), particulate organic C (66%), particulate organic N (2.4 fold) and soil microbial biomass C (28%) at a depth of 0-200 mm than adjacent land in conservation-tillage cropland (24 yr old). Soil organic C and total N at a depth of 0-200 mm averaged 3800 and 294 g m⁻², respectively, under grazed bermudagrass and 3112 and 219 g m⁻², respectively, under hayed bermudagrass. A chronosequence of grazed tall fescue suggested soil organic N sequestration rates of 7.3, 4.4 and 0.6 g m⁻² yr⁻¹ to a depth of 200 mm during 0-10, 10-30 and 30-50 yr, respectively. Soil C storage under long-term grazed tall fescue was 85 to 88% of that under forest, whereas soil N storage was 77 to 90% greater under grazed tall fescue than under forest. Properly grazed pastures in the Southern Piedmont USA have great potential to restore natural soil fertility, sequester soil organic C and N and increase soil biological activity. This citation is from AGRICOLA.

137. The soil structure component of soil quality under alternate grazing management strategies.

Southorn, Neil J.

In: Sustainable land management: Environmental protection: A soil physical approach/ Pagliai, Marcello and Jones, Robert; Vol. 35.
Reiskirchen, Germany: Catena Verlag, 2002; pp. 163-170.
Notes: Meeting Information: International Conference on Sustainable Soil Management for Environmental Protection: Soil Physical Aspects, Firenze, Italy; July 02-07, 2001; ISBN: 3923381484

NAL Call #: S596 .158 2001

Descriptors: alternate grazing management: applied and field techniques/ image analysis: imaging and microscopy techniques, laboratory techniques/ soil properties: bulk density, hydraulic conductivity, microbial activity, organic carbon content, penetration resistance, pore geometry/ soil quality: soil structure component
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138. Soil water regimes of rotationally grazed perennial and annual forages.

Twerdoff, D. A.; Chanasyk, D. S.; Naeth, M. A.; Baron, V. S.; and Mapfumo, E.

Canadian Journal of Soil Science 79(4): 627-637. (1999)
NAL Call #: 56.8 C162; ISSN: 0008-4271

Descriptors: rotational grazing: agronomic method, annual

forages, perennial forages/ evaporation/ soil water regime/ water use efficiency

Abstract: To maintain a sustainable agricultural system, management practices such as grazing must ensure adequate soil water for plant growth, yet minimize the risk of soil erosion. The objective of this study was to characterize the soil water regime of perennial and annual forages under three grazing intensities (heavy, medium and light). The study was conducted at the Lacombe Research Station, Alberta, on an Orthic Black Chernozem of loam to silt loam texture. The forages used were smooth brome grass (*Bromus inermis* L. 'Carlton'), meadow brome grass (*Bromus riparius* L. 'Paddock'), a mixture of triticale (X *Triticosecale* Wittmack 'Pika') and barley (*Hordeum vulgare* L. 'AC Lacombe') and triticale. Soil water measurements were conducted between April and October of 1994 and 1995 using a neutron scattering hydroprobe to a depth of 90 cm. Surface (0-7.5 cm) soil water was more responsive to grazing intensity than soil water accumulated to various depths. For all grazing treatments and forages, both surface soil water and accumulated soil water generally fluctuated between field capacity and wilting point during the growing season. Although plant water status was not determined, no visual permanent wilting of forages was observed during the study. Differences in evapotranspiration (ET), as determined by differences in soil water were evident among forage species but not grazing intensities, with perennials having high ET in spring and annuals having high ET in summer. Estimated values of water-use efficiency (WUE) were greater for perennials than for annuals and grazing effects on WUE were minimal. From a management perspective, grazing of annuals and perennials altered soil water dynamics but still maintained adequate soil water for plant growth.

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139. Spatial variability of soil total C and N and their stable isotopes in an upland Scottish grassland.

Marriott, C. A.; Hudson, G.; Hamilton, D.; Neilson, R.; Boag, B.; Handley, L. L.; Wishart, J.; Scrimgeour, C. M.; and Robinson, D.

Plant and Soil 196(1): 151-162. (1997)

NAL Call #: 450 P696; ISSN: 0032-079X

Descriptors: geostatistics/ grazing management/ spatial variability/ total soil carbon/ total soil nitrogen

Abstract: As preparation for a below ground food web study, the spatial variability of three soil properties (total N, total C and pH) and two stable isotopes ($\delta^{13}C$ and $\delta^{15}N$ of whole soil) were quantified using geostatistical approaches in upland pastures under contrasting management regimes (grazed, fertilized and ungrazed, unfertilized) in Scotland. This is the first such study of upland, north maritime grasslands. The resulting patterns of variability suggest that to obtain statistically independent samples in this system, a sampling distance of greater than 13.5 m is required. Additionally, temporal change (a decline of 1permil) was observed in whole soil $\delta^{15}N$ for the grazed, fertilized plot. This may have been caused by new inputs of symbiotically-fixed atmospheric N_2 .

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140. Spatial variation of plant-available phosphorus in pastures with contrasting management.

Sauer, Thomas J. and Meek, David W.

Soil Science Society of America Journal 67(3): 826-836. (2003)

NAL Call #: 56.9 So3; ISSN: 0361-5995

Descriptors: contrasting management systems/ grazing/ pH level/ pasture/ poultry litter/ spatial variation

Abstract: Land application of animal manure, at rates based on soil nutrient content or crop requirements, optimizes nutrient recycling and minimizes offsite environmental impacts. The objective of this research was to characterize the spatial variation of plant-available P and other soil properties (C, N, and pH) in two pastures having contrasting grazing and poultry litter management. One site (Cellar Ridge) was a lightly grazed 6-ha tall fescue (*Festuca arundinacea* Schreb.) pasture with limited poultry litter application and the other (Haxton) was a 9.5-ha tall fescue pasture with annual poultry litter application and intensive rotational grazing for 10 yr. Soil cores (0-0.15 m) were collected on a 30-m grid at both sites and analyzed for plant-available P (Mehlich-3 extract), total C and N (combustion method), and pH (1:1 water/0.01 M CaCl₂). Cellar Ridge had significantly less Mehlich-3 extractable P (32 vs. 341 mg kg⁻¹), more acid pH (5.25 vs. 5.73), and significantly greater C (23.3 vs. 16.3 g C kg⁻¹) and N (1.76 vs. 1.54 g N kg⁻¹). Spatial dependence over approximately 1 to 3 lag distances with a consistent orientation (across ridge) was observed for all parameters at Cellar Ridge. No spatial dependence was observed for Mehlich-3 P, C, N, or pH at the Haxton site (all parameters exhibiting nugget effect). Ten years of poultry litter application likely eliminated spatial structure for these properties. Further research is needed to determine whether additional costs associated with grid sampling and variable rate litter application can be justified.

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141. Stocking method effects on nutrient runoff from pastures fertilized with broiler litter.

Kuykendall, H. A.; Cabrera, M. L.; Hoveland, C. S.; Mccann, M. A.; and West, L. T.

Journal of Environmental Quality 28(6): 1886-1890. (1999)

NAL Call #: QH540.J6; ISSN: 0047-2425

Descriptors: nutrients/ runoff/ pastures/ fertilization/ litter/ forages/ cattle/ agricultural practices/ grazing/ water quality/ fate of pollutants/ agricultural runoff/ fertilizers/ animal wastes/ manure/ land (grass and pasture)/ animal foodstuffs/ cattle (see also livestock)/ water quality (natural waters)/ *Bos taurus*/ *Gallus gallus domesticus*/ *Festuca arundinacea*/ *Cynodon dactylon*

Abstract: Repeated applications of broadcast broiler (*Gallus gallus domesticus*) litter can increase nutrient runoff from pastures. Rotational stocking (RS) of cattle, as compared with continuous stocking (CS), may be useful in decreasing surface nutrient runoff because of better manure distribution and more uniform forage accumulation to act as filters and trap nutrients. Our objective was to measure nutrient runoff from six 0.75-ha tall fescue (*Festuca arundinacea* Schreb.)-common bermudagrass [*Cynodon dactylon* (L.) Pers.] pastures fertilized with 13 to 15 Mg (dry weight) broiler litter per hectare per year and managed under RS or CS. Two cross-bred beef (*Bos taurus*) steers were maintained on each pasture year around for 2 yr, with additional steers added to maintain

similar forage availability between stocking methods. In each pasture, surface runoff was directed to a flume where it was sampled by an automatic sampler. Runoff was analyzed for total Kjeldahl N, (NO sub(3) super(-) + NO sub(2) super(-)-N, NH sub(4) super(+)-N, total Kjeldahl P, and dissolved reactive P (DRP). Grazing method had no effect ($P > 0.10$) on surface runoff quality or quantity. Average runoff expressed as a percentage of the rain was 15% for the first year and 12% for the second year. The average flow-weighted concentrations of DRP and NH sub(4) super(+)-N were 5.08 mg P L super(-1) and 1.07 mg N L super(-1) for the first year, and 8.22 mg P L super(-1) and 10.11 mg N L super(-1) for the second year ($P < 0.10$). © CSA

142. Stormflow and sediment loss from intensively managed forest watersheds in east Texas.

Blackburn, W. H.; Knight, R. W.; Wood, J. C.; and Pearson, H. A.

Water Resources Bulletin 26(3): 465-178. (1990)

NAL Call #: 292.9 Am34; ISSN: 0043-1370

Descriptors: watersheds/ sediment transport/ river discharge/ forest industry/ resource management/ environmental impact/ USA, Texas, east

Abstract: Five small (4 ha) forested watersheds in East Texas were instrumented in December 1980 to determine the effect of forest harvesting, mechanical site preparation, and livestock grazing on stormflow, peak discharge rate, and sediment loss. After three pretreatment years, four of the watersheds were treated as follows: (1) clearcutting followed by roller chopping; (2) clearcutting following by shearing and windrowing; (3) clearcutting following by shearing, windrowing, and continuous grazing; and (4) clearcutting followed by shearing, windrowing, and rotational grazing. Clearcut harvesting and all site preparation treatments significantly increased stormflow, peak discharge, and sediment losses over the undisturbed condition. Roller chopping and shearing/windrowing had little impact on sediment loss from these watersheds and appears to be a sound forest conservation practice for gently sloping watersheds (<8 percent). As applied, livestock grazing had minimal impact on stormflow and peak discharge. The moderately stocked continuously grazed treatment had little impact on sediment loss, but the high stocking density of the rotational grazing treatment increased sediment losses over the undisturbed condition. Sediment losses from these intensively managed forest watersheds, even though significantly greater than from undisturbed conditions, were within the range of sediment losses from undisturbed watersheds in the Southeast, below the range of losses from mechanically prepared watersheds elsewhere, and well below potential losses from pasture and cropland. (DBO) © CSA

143. Streambank erosion associated with grazing practices in Central Kentucky.

Agouridis, C. T.; Edwards, D. R.; Workman, S. R.; Bicudo, J. R.; Taraba, J. L.; Vanzant, E. S.; and Gates, R. S.

In: 2004 ASAE Annual International Meeting. (Held 1 Aug 2004-4 Aug 2004 at Ottawa, Ontario, Canada.); pp. 2949-2974; 2004.

NAL Call #: S671.3 .A54

Descriptors: BMP/ management/ riparian/ soil loss

Abstract: Research into the effects of cattle grazing on

stream health has been well documented in the western portion of the United States, but is lacking in the east. Western researchers have estimated that 80% of the damage incurred by stream and riparian systems in these arid environments was from grazing livestock. Stream and riparian damage resulting from grazing includes alterations in watershed hydrology, changes to stream morphology, soil compaction and erosion, destruction of vegetation, and water quality impairments. The objective of this project was to provide the agricultural community with a better understanding of the impacts of cattle grazing on stream bank erosion so as to enhance current cattle production methods on farms in the humid region of the U.S. The project site, located on the University of Kentucky's Animal Research Center, consisted of two replications of three treatments: control, selected BMPs with free access to the stream, and selected BMPs with limited access to the stream. Fifty permanent cross sections were established throughout the project site. Over a two year period, 18 surveys were conducted using conventional surveying techniques. Changes in stream cross sectional area were used to quantify soil loss or gain associated with the different treatment levels. Results from this project indicated that streambank erosion can be minimized through the incorporation on a BMP system (with or without a fenced riparian area). In the absence of a protected riparian zone, grazing managers should modify their practices to minimize cattle activity (i.e. flash grazing, no grazing), and associated erosion along streambanks, during periods characterized by higher flows and/or hot humid conditions. © 2006 Elsevier B.V. All rights reserved.

144. Streambank erosion associated with grazing practices in the humid region.

Agouridis, C. T.; Edwards, D. R.; Workman, S. R.; Bicudo, J. R.; Koostra, B. K.; Vanzant, E. S.; and Taraba, J. L.

Transactions of the ASAE 48(1): 181-190. (2005)

NAL Call #: 290.9 Am32T; ISSN: 0001-2351

[http://www.bae.uky.edu/WQ406/publications/TransASAE48\(1\)181-190.pdf](http://www.bae.uky.edu/WQ406/publications/TransASAE48(1)181-190.pdf)

Descriptors: bank erosion/ cattle/ grazing/ best management practices/ riparian areas/ streams/ fences/ erosion control/ Kentucky

Abstract: The effects of cattle grazing on stream stability have been well documented for the western portion of the U.S., but are lacking for the east. Stream and riparian damage resulting from grazing can include alterations in watershed hydrology, changes to stream morphology, soil compaction and erosion, destruction of vegetation, and water quality impairments. However, few studies have examined the successes of best management practices (BMPs) for mitigating these effects. The objective of this project was to assess the ability of two common BMPs to reduce streambank erosion along a central Kentucky stream. The project site consisted of two replications of three treatments: (1) an alternate water source and a fenced riparian area to exclude cattle from the stream except at a 3.7 m wide stream ford, (2) an alternate water source with free stream access, and (3) free stream access without an alternate water source (i.e., control). Fifty permanent cross-sections were established throughout the project site. Each cross-section was surveyed monthly from April 2002 until November 2003. Results from the project indicated that the incorporation of an alternate water source and/or fenced riparian area did not significantly alter stream

cross-sectional area over the treatment reaches. Rather than exhibiting a global effect, cattle activity resulted in streambank erosion in localized areas. As for the riparian exclosures, changes in cross-sectional area varied by location, indicating that localized site differences influenced the processes of aggradation and/or erosion. Hence, riparian recovery within the exclosures from pretreatment grazing practices may require decades, or even intervention (i.e., stream restoration), before a substantial reduction in streambank erosion is noted. This citation is from AGRICOLA.

145. Study of the contribution of nutrients to the soil by the feces of cows grazing in 3 rotational systems.

Suarez, J. J.; Senra, A.; and Galindo, J. L.
Cuban Journal of Agricultural Science 15(1): 95-102. (1981)
NAL Call #: S1.R4; ISSN: 0864-0408

Descriptors: classification model/ paddock system/ phosphorus/ potassium

Abstract: The contribution of nutrients to the soil by feces of cows grazing 18 h/day in 3 rotational systems (8, 4 and 2 paddocks) was studied in the dry season of 1978. The measurements were as follows: feces number/cow, feces diameter and content of organic matter (DM), P and K in the soil. A simple classification model was used. The feces number/cow (10.1 and 11.5) was higher in the systems of 8 and 4 paddocks compared with the 2 paddock system (7.5). The diameters (26.1; 25.7 and 26.7 cm) of the feces were similar in the 3 systems. The percentage of the covered area/paddock per yr was low (6.28, 6.99 and 5.19%). The amount (kg/ha per yr) of nutrients supplied by feces (40, 50 and 52 kg of N; 9, 11 and 7 kg of P and 10, 12 and 8 kg of K in the 8, 4 and 2 paddock system, respectively) was low. In the 1st yr of grazing the DM and K contents in the soil increased ($P < 0.001$), while the P content decreased ($P < 0.001$). Under grazing conditions, the contribution of N and P to the soil by the feces are so poor that their application is still needed. The increase of K content in the soil could save applications of this nutrient.

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146. The use of a nitrification inhibitor, dicyandiamide (DCD), to decrease nitrate leaching and nitrous oxide emissions in a simulated grazed and irrigated grassland.

Di, H. J. and Cameron, K. C.
Soil Use and Management 18(4): 395-403. (2002)
NAL Call #: S590.S68; ISSN: 0266-0032

Descriptors: lysimeter: field equipment/ dairy farms/ drainage water: nitrate concentration/ free draining lismore stony silt loam: udic haplustept loamy skeletal/ grazed dairy pasture systems/ grazed paddock/ herbage production/ simulated grassland: grazed, irrigated/ water quality

Abstract: In grazed dairy pasture systems, a major source of NO₃- leached and N₂O emitted is the N returned in the urine from the grazing animal. The objective of this study was to use lysimeters to measure directly the effectiveness of a nitrification inhibitor, dicyandiamide (DCD), in decreasing NO₃- leaching and N₂O emissions from urine patches in a grazed dairy pasture under irrigation. The soil was a free-draining Lismore stony silt loam (Udic Haplustept loamy skeletal) and the pasture was a mixture of perennial ryegrass (*Lolium perenne*) and white clover (*Trifolium repens*). The use of DCD decreased NO₃--N leaching by 76% for the urine N applied in the autumn, and

by 42% for urine N applied in the spring, giving an annual average reduction of 59%. This would reduce the NO₃--N leaching loss in a grazed paddock from 118 to 46 kg N ha⁻¹ yr⁻¹. The NO₃--N concentration in the drainage water would be reduced accordingly from 19.7 to 7.7mg N L⁻¹, with the latter being below the drinking water guideline of 11.3 mg N L⁻¹. Total N₂O emissions following two urine applications were reduced from 46 kg N₂O-N ha⁻¹ without DCD to 8.5 kg N₂O-N with DCD, representing an 82% reduction. In addition to the environmental benefits, the use of DCD also increased herbage production by more than 30%, from 11 to 15 t ha⁻¹ yr⁻¹. The use of DCD therefore has the potential to make dairy farming more environmentally sustainable by reducing NO₃- leaching and N₂O emissions.

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147. Use of fertilization and grazing exclusion in mitigating lost meadow production in the Sierra Nevada, California, USA.

Kie, J. G. and Myler, S. A.
Environmental Management 11(5): 641-648. (1987)
NAL Call #: HC79.E5E5; ISSN: 0364-152X

Descriptors: agriculture/ ammonium phosphate/ dolomite/ mitigation/ hydroelectric development/ denitrification/ graminoids/ forbs

Abstract: The effects of single fertilizer treatment (ammonium phosphate at 841 kg/ha, plus dolomite at 336 kg/ha) and cattle exclusion were studied in two meadows in the Sierra Nevada of California in the USA. Grazing exclusion had no effect on soil bulk density during the three years of the study. Fertilization had no effect on total soil nitrogen, soil pH, or crude protein concentrations in graminoids or forbs. Saturated soils and the development of anaerobic conditions close to the surface may have led to denitrification and the loss of usable nitrogen. Fertilization did result in short-term (one- to two-year) increases in available solid phosphorus in the drier of the two meadows, and in total phosphorus concentrations in graminoids and forbs, which were otherwise generally deficient in phosphorus. Few changes in plant species composition or production were detected, although a combination of fertilization and grazing exclusion increased forb production in the drier meadow. Based on our initial results, fertilization with phosphorus was the recommended treatment for meadow improvement projects in the central Sierra Nevada.

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148. Using constructed wetlands to treat subsurface drainage from intensively grazed dairy pastures in New Zealand.

Tanner, C. C.; Nguyen, M. Long; and Sukias, J. P. S.
Water Science and Technology 48(5): 207-213. (2003)
NAL Call #: TD420.A1P7; ISSN: 0273-1223

Descriptors: intensively grazed dairy pastures: subsurface drainage/ non point source pollution

Abstract: Performance data, during the start-up period, are presented for constructed wetlands treating subsurface drainage from dairy pastures in Waikato (rain-fed) and Northland (irrigated), North Island, New Zealand. The wetlands comprised an estimated 1 and 2% of the drained catchment areas, respectively. Nitrate concentrations were high in the drainage inflows at both sites (medians 10 g m⁻³ at Waikato and 6.5 g m⁻³ at Northland), but organic N was

also an important form of N at Waikato (37% of TN). Comparison of wetland inflow and outflow nutrient concentrations showed overall nutrient reductions during passage through the wetlands for NO₃-N (34 and 94% for medians, respectively), TN (56 and 33%, respectively), and DRP (80%, Northland only). Median NH₄-N (both sites) and DRP (Waikato) concentrations showed apparent increases between the wetland inlets and outlets. However, a mass balance calculated for the 3 month preliminary monitoring periods showed substantial mass removal of DRP (80%) and all measured forms of N (NO₃-N 78%, NH₄-N 41%, Org-N 99.8% and TN 96%) in the Waikato wetland. Monitoring of these systems needs to be continued through a range of seasons and years to fully assess their long-term performance.

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149. Using nitrogen-15 to quantify vegetative buffer effectiveness for sequestering nitrogen in runoff.

Bedard-Haughn, A.; Tate, K. W.; and Van Kessel, C. *Journal of Environmental Quality* 33(6): 2252-2262. (2004) NAL Call #: QH540.J6; ISSN: 0047-2425

Descriptors: water pollution/ pollution control/ nitrogen/ losses from soil/ agricultural runoff/ ground vegetation/ filter strips/ conservation buffers/ environmental fate/ soil transport processes/ pastures/ irrigation/ grazing/ nutrient uptake/ stable isotopes/ California

Abstract: Previous studies have observed higher levels of soluble nutrients leaving vegetative buffers than entering them, suggesting that the buffers themselves are acting as a source rather than a sink by releasing previously stored nutrients. This study used 98 atom % ¹⁵N-labeled KNO₃ at a rate of 5 kg ha⁻¹ to quantify buffer efficiency for sequestering new inputs of NO₃(-)-N in an extensively grazed irrigated pasture system. Buffer treatments consisted of an 8-m buffer, a 16-m buffer, and a nonbuffered control. Regardless of the form of runoff N (NO₃(-), NH₄(+), or dissolved organic nitrogen [DON]), more ¹⁵N was lost from the nonbuffered treatments than from the buffered treatments. The majority of the N attenuation was by vegetative uptake. Over the course of the study, the 8-m buffer decreased NO₃(-)-¹⁵N load by 28% and the 16-m buffer decreased load by 42%. For NH₄(+)-¹⁵N, the decrease was 34 and 48%, and for DON-¹⁵N, the decrease was 21 and 9%. Although the buffers were effective overall, the majority of the buffer impact occurred in the first four weeks after ¹⁵N application, with the buffered plots attenuating nearly twice as much ¹⁵N as the nonbuffered plots. For the remainder of the study, buffer effect was not as marked; there was a steady release of ¹⁵N, particularly NO₃(-)- and DON-¹⁵N, from the buffers into the runoff. This suggests that for buffers to be sustainable for N sequestration there is a need to manage buffer vegetation to maximize N demand and retention. This citation is from AGRICOLA.

150. Water-quality benefits of having cattle manure deposited away from streams.

Larsen, Royce E.; Miner, J. Ronald; Buckhouse, John C.; and Moore, James A.

Bioresource Technology 48(2): 113-118. (1994) NAL Call #: TD930.A32; ISSN: 0960-8524

Descriptors: cattle industry/ agriculture/ bacterial transport/ methods/ soil permeability/ water pollution/ weather

Abstract: A series of runoff and infiltration studies with

bovine feces placed 0.0, 0.61, 1.37, or 2.13 m from a collection point were used to assess effectiveness of vegetative fiber strips. Effectiveness was evaluated on the ability of the separation distance to reduce the number of fecal coliform (FC) bacteria being transported from the manure to the edge of the plots. Bacterial transport was evaluated under conditions of variable distance, soil permeability, and rainfall intensity. The FC bacteria yields were 40-115 million at the edge of the manure pile. This is only 17% of the FC in the manure. FC concentrations and yields were further reduced as the separation increased. The analysis of data did not indicate significant differences of bacteria transport in relation to rainfall intensities of 5 cm/h versus 10 cm/h at the 0.61, 1.37, or 2.13 m distances. © The Thomson Corporation

151. Water quality implications of dairy slurry applied to cut pastures in the northeast USA.

Stout, W. L.; Weaver, S. R.; Gburek, W. J.; Folmar, G. J.; and Schnabel, R. R.

Soil Use and Management 16(3): 189-193. (2000) NAL Call #: S590.S68; ISSN: 0266-0032

Descriptors: drainage lysimeter: equipment/ animal grazing/ dairy slurry: feces, urine/ drinking water standard/ groundwater pollution: non point source/ leaching/ soil type/ US EPA: government agency

Abstract: Nitrate nitrogen (NO₃-N) leaching from animal production systems in the northeast USA is a major non-point source of pollution in the Chesapeake Bay. We conducted a study to measure NO₃-N leaching from dairy slurry applied to orchardgrass (*Dactylis glomerata* L., cv. Pennlate) using large drainage lysimeters to measure the direct impact of four rates of slurry (urine and faeces) N application (0, 168, 336, 672 kg N ha⁻¹ yr⁻¹) on NO₃-N leaching on three soil types. We then used experimentally-based relationships developed earlier between stocking density and NO₃-N leaching loss and leachate NO₃-N concentration to estimate the added impact of animal grazing. Nitrate N leaching losses from only dairy slurry applied at the 0, 158, 336, and 672 kg N ha⁻¹ yr⁻¹ rates were 5.85, 8.26, 8.83, and 12.1 kg N ha⁻¹ yr⁻¹, respectively with corresponding NO₃-N concentrations of 1.60, 2.30, 2.46, and 3.48 mg l⁻¹. These NO₃-N concentrations met the 10 mg l⁻¹ US EPA drinking water standard. However, when a scenario was constructed to include the effect of NO₃-N leaching caused by animal grazing, the NO₃-N drinking water standard was calculated to be exceeded. © The Thomson Corporation

152. Water quality implications of nitrate leaching from intensively grazed pasture swards in the northeast US.

Stout, W. L.; Fales, S. L.; Muller, L. D.; Schnabel, R. R.; and Weaver, S. R.

Agriculture, Ecosystems & Environment 77(3): 203-210. (2000)

NAL Call #: S601.A34; ISSN: 0167-8809

Descriptors: *Dactylis glomerata*/ *Medicago sativa*/ *Trifolium repens*/ pastures/ water quality/ leaching/ nitrates/ groundwater/ stocking rate/ range management/ nitrate nitrogen/ nitrogen fertilizers/ groundwater contamination/ intensive livestock farming/ Pennsylvania

Abstract: High density animal production systems, such as management intensive grazing (MIG), can have a negative effect on water quality. Learning to manage such systems to minimize water quality impacts is essential for the